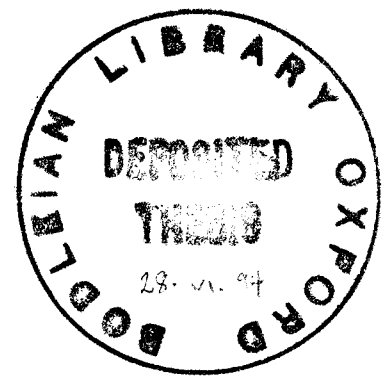
INDIAN INDUSTRY 1950-1990: GROWTH, DEMAND AND PRODUCTIVITY

Thesis submitted for the D.Phil. in Economics
Michaelmas Term 1993

Ranu Dayal
New College, Oxford



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Industry in India has grown at different rates in different periods since 1950. Policy liberalization and increased deficit financing provides the context for an explanation of the acceleration in industrial growth in the 1980s.

In this thesis I develop a model of demand for industrial products using time series macro-econometric methods after first establishing that industrial prices in India are largely determined by costs. Using the Johansen Maximum Likelihood method, I formulate an overall consumption function and develop an error correction model of the demand for industrial output arising from consumption. I demonstrate that public equipment investment crowds out private investment in machinery and equipment and model demand for the purpose of equipment investment. With the help of recursive techniques, the models of consumption and investment are shown to be well specified and stable over the entire period considered, including the eighties. I contend that domestic factors were more important in increasing growth than the expansion of manufactured exports.

Stagnant levels of employment provide the backdrop for an examination of productivity growth in industry. I demonstrate that a limited improvement in total factor productivity was achieved subsequent to the acceleration in output growth in the 1980s. I question the assertion that productivity growth was responsible for the acceleration in output growth and refute the related contention that liberalization engendered the improvement in productivity. I establish that capital and labour inputs are able to account for the movements in industrial output only to a limited extent and demonstrate that consideration of raw material inputs is essential to an adequate explanation of supply side dynamics.

My analysis contends that changes in demand were accommodated by supply responses, which may have been aided by the relaxation of regulatory controls.

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I

AN INTRODUCTION

The aggregate rate of industrial growth in India increased from 4.5 % p.a. in the period from 1965 to 1980 to 8 % p.a. in the 1980s. This rate of growth has declined in only 2 out of the 11 years between 1980 and 1991.[1] Correspondingly, there is need for a model to account for this change in the "natural" or "steady state" rate of growth of industrial output.

The primary objective of this dissertation is the identification of the causes of general growth and industrial development in the Indian context. I hope to provide some understanding of the growth process in industry and to locate the primary influences on the dynamics of industrial production in a quantitative, data-coherent fashion for the period from 1950 to 1989.

This dissertation will also attempt to provide an assessment of the liberalization - growth issue and establish if the acceleration in industrial growth in the 1980s can be attributed to supply-side changes or changes in the nature of demand. By its very nature, this dissertation will attempt to provide an analysis of policy with respect to the industrial sector, and briefly suggest what kinds of changes in policy may be beneficial in the future.

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[1] Latest reports seem to suggest that a deep recession is afflicting industry, with an absolute decline in output in the first half of 1991-92. In particular, the capital goods sector has declined by as much as 19% over the course of six months. This can be attributed in no small measure to the impact of the severe foreign exchange and payments crisis that came to a head in the aftermath of the Gulf war.

The value of this study lies in the great importance of the industrial sector, both in and of itself, and in a wider development context. The fortunes of industry and the economy are closely tied in any economy, and the constancy of long term growth in Indian agriculture reinforces these links. For any improvement in the economic situation in India, it is critical that the industrial sector expand, and expand at a rate far greater than achieved so far, and in a manner that will enable more of her people to enjoy an acceptable standard of living, free of the wretched compulsions that poverty imposes.

This thesis constitutes an honest attempt to apply recently developed techniques of empirical economic analysis to practical concerns. Throughout the dissertation, I will apply the econometric philosophy and methods pioneered by the study of the consumption function now known as DHSY to a context far removed from the original, but hopefully with as much success.[2] I hope that some of the results obtained in this study will enhance the understanding of the Indian macro-economy and prove useful in informing policy.

A short story

My interest in industrial growth developed as an undergraduate when the 'stagnation' debate was reaching an end, though no firm conclusion was forthcoming. Attempting to understand the complex interactions that influence industrial performance has illustrated the importance of learning by doing in my search for methods to address the issues that the stagnation debate raises. Before settling on what has been called the

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[2]Davidson, et al (1978). A perspective on the contribution of DHSY to econometric modelling is presented in Hendry, et al (1990).

"single equation error correction mechanism" approach, I considered using a macro-model, large as well as 'small', in addition to simultaneous equation methods.

Macro-models have declined in popularity, partly on account of their continual predictive failure, and partly because of their inability to reveal the nature of the interactions they were allegedly designed to display. The interest in small macro-models has also passed with the limited empirical success of such models. The interest in real business cycle theory kindled interest in unit roots and random walks at about the same time that the SEECM methodology was being developed and refined, and a rationalisation of the methods used was found in terms of cointegration, long run equilibria and short run dynamics. While in Oxford, exposure to the proselytizing zeal and enthusiasm of David Hendry and the quiet conviction of Grayham Mizon convinced me that this approach of data coherent modelling could provide a useful method of studying industrial growth.

Apart from other considerations, the non-availability of consistent figures on supply aspects and features of demand prevented me from modelling the two jointly, and making progress with the troublesome, and perhaps even misguided, question of the relative importance of demand and supply in the determination of industrial growth. As it is, the tentative conclusion that changes in demand initiated, and supply responses accommodated, the acceleration in growth in the 1980s is probably as good an answer as a joint model of supply and demand could have provided.

A plan of the dissertation

Chapter II provides a brief history of policy with respect to the industrial sector, and looks at figures for the performance of this sector, particularly

in the 1980s. Here, I present the main ideas advanced in the context of the stagnation in industrial production since the mid-sixties, introducing my own questions and qualifications.

Chapter III outlines the nature of the macro-econometric methodology that I utilise.

The approach to modelling the demand for industry is presented in Chapter IV, as is a description and analysis of the main features of government consumption and investment expenditure.

Chapter V develops a model of price determination in industry. This model emphasizes the importance of cost terms in the determination of industrial prices, and the countercyclical influence of demand on price formation, setting the stage for an estimation of demand for industrial output.

A model of consumption demand for industrial output is developed in Chapter VI. I first develop a DHSY type consumption function, and then present a specification for a consumption function that relates to industrial products.

Chapter VII focuses on the demand for investment goods produced in the industrial sector. The links between public and private fixed capital formation are explored, and a model for private demand for machinery and investment is developed.

The role of the external sector in influencing demand for industry is investigated in Chapter VIII. The chapter concludes by bringing together the main findings on the various components of demand for industrial output.

The issue of productivity growth is at the centre of an analysis of supply-side influences on industrial output in Chapter IX. A model of output as a function of inputs for the industrial sector as a whole, and a similar model for the manufacturing sector alone are also developed here.

Chapter X brings together the findings of the earlier chapters and attempts to place the experience of industrial change within the context of a model that combines demand and supply aspects. A perspective on the relationship between the acceleration in industrial output and the change in the policy regime is presented.

Chapter XI provides a summary.

II

BACKGROUND

To broach the issues considered in the rest of this dissertation, this chapter provides a short introduction to the backdrop of the liberalization policies and the improvement in aggregate industrial growth in the 1980s. I review briefly the literature on Indian industrial growth, largely originating in the context of the stagnation since the mid-1960s and highlight the limitations of the data available. The salient trends in post-Independence industrial development are discussed in the last sub-section.

The Context of Liberalization in Policy

In 1984, the Rajiv Gandhi government assumed office and accelerated the process of change in Indian economic policy that had itself been initiated after the return to power of the Congress (I) in 1979. 1984 was also the year marked by the early suggestions that the "stagnation" in industrial output since the mid-sixties had possibly ended. With the benefit of hindsight it seems strange that such suggestions were tentative, but the delay in the publication of statistics makes it difficult to provide support for timely opinions of this kind.

Raj in 1984 argued that there had "been possibly some increase in the rate of growth of industrial output since the middle of the 1970s raising it closer to the levels achieved in the 1950s and 1960s".[1] However, he

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[1]See Raj (1984) for an analysis of smoothed time-series graphs of gross value-added in manufacturing for the period 1952-53 to 1982-83.

expressed reservations about making strong assertions in the absence of a sufficiently long series of data.

Alagh in 1985 provided further support to this view by contrasting the performance of the registered industrial sector in the period from 1971 to 1976 with that of the period from 1976 to 1984. The annual growth rate for the latter period was estimated as being three percentage points higher than the 4.6 % per annum achieved in the first period.[2] On the other hand, in her influential account of industrial performance, Ahluwalia (1985) voiced the opinion that there appeared to have been no recovery from the stagnation of the mid-sixties, even if the first two years of the eighties were taken into account.[3]

The Economic Survey for 1985-86 showed that the Index of Industrial Production (IIP) - with 1970-71 as the base year underestimated growth for the period 1974-75 to 1982-83 at 4.4% annually in comparison with the Annual Survey of Industries (ASI) which enumerated the growth at 8.0% for the same period. Accordingly, the IIP was revised with 1980-81 as the new base year. The new series revealed the enhanced growth rate of the eighties quite clearly. Critics of the revisions in the IIP claimed that these were arbitrary and overestimated growth, but most nevertheless acknowledged that there had been a recovery in industrial growth.[4] More recently, Nagaraj (1989) demonstrated that there had been an improvement in industrial growth in the eighties compared to that since the mid-sixties, regardless of the particular index of

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[2]Alagh (1985).

[3]Ahluwalia (1985).

[4]Chandrashekhar (1988) and Kurien (1989) express this view.

production used, and that this improved growth rate for the eighties compared with, if not rivalled, the growth rate attained in the seven year period preceding the mid-sixties, widely accepted as being one of high growth.

From an international perspective, the World Development Report (1989) estimated the annual rate of industrial growth at 7% per annum for the eighties, lower only than that for China and Pakistan among the countries at a similar level development. This dynamism, perhaps not surprisingly, extended to other facets of the economy as well, and National Income also grew at record levels in the eighties.[5]

TABLE II.1:Real National Income : Rates of Growth (%)

Period	1950-51 - 1960-61	1960-61 - 1970-71	1970-71 - 1980-81	1980-81 - 1988-89	1950-51 - 1988-89
Annual growth rate	3.7	3.2	3.4	4.8	3.6

Source: Basic Statistics Relating to the Indian Economy (1989)

The absence of any corresponding increase in the trend rate of growth of agriculture provides perspective to the improved performance in national and industrial growth. Agricultural production fluctuated

[5]Bhargava and Joshi (1990) trace the increase in India's growth rate to the growth of private sector GDP. Taking 1980-1 as the break year, they view mining and quarrying, other transport and other services as significant influences on the overall growth rate, apart from identifying registered manufacturing as a significant influence.

widely in this relatively short period and a series of near famines were experienced between 1984 and 1987.

Not just the overall rate of growth but also the sectoral composition of industrial production as well appears to have undergone marked change, with industrial areas like chemicals and chemical products, petrochemicals, and food processing coming to the fore and recording the highest growth.

This apparent break with the past occurs at a time when the Government of India began pursuing a strategy in line with global trends, a policy that can best be described by the catchword 'liberalization'.[6] The process of liberalization in India reflects a gradual evolution of policy and regulatory principles, and not a sudden, definitive break with the past. The case for a change in policy was made by a number of official committees, the more important being the Alexander Committee (Government of India (1978)), the Dagli Committee (G.O.I. (1979)), the Hussain Committee (G.O.I. (1984)) and the Narasimham Committee (G.O.I. (1985 b)).[7] The recommendations of these committees widened in scope and were more radical and far-reaching in character in successive years. There was unquestionably a quickening of the pace of change of the panoply of controls and macro-economic policies in the second half of the eighties.

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[6]Also referred to as "deregulation", or the "new economic policies".

[7]The Committees headed by Pande , Rajadhyaksha and Tandon also submitted their recommendations in 1980 (G.O.I. 1980a, 1980b, 1980c respectively). Kelkar and Kumar (1990) provide an overview of the main changes and a perspective on Indian macroeconomic policies in general can be found in Ahluwalia (1989) and Joshi and Little (1989).

The main elements of this liberalization were: internal liberalization; external liberalization; and the Long Term Fiscal Policy (LTFP) of 1985. These elements were, and continue to be, parts of an overall strategy to place a generally greater reliance on the market and price signals than upon administered controls, and thereby reduce the extent of bureaucratic red tape.

The 'internal' measures, aimed at removing domestic regulatory barriers on the entry and exit of firms, consisted of a variety of measures: delicensing of several broad industry groups; 'broadbanding' of licences to facilitate horizontal diversification within a particular product group and allow flexibility in output mix; automatic re-endorsement of capacity expansion of up to 25% of licensed capacity; raising of investment limits for inclusion in the 'small-scale' category; raising of the limits for exemption from the purview of the Monopolies and Restrictive Trade Practices Commission (MRTPC)[8]; concessions for firms under the MRTPC and those governed by the Foreign Exchange Regulation Act which operated in 'priority' areas such as export promotion or were located in designated 'backward areas'; and various sectoral approaches such as that of the Textiles Policy of 1986.

This gradualist policy for increasing the scope of delicensing to certain sectors and certain activities was ended in 1991, when all but a few sensitive industries concerned with defence and nuclear power were delicensed. The Statement on Industrial Policy of 1991 also introduced relaxations in policy with respect to foreign investment, allowing 51%

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[8]This limit was raised to Rs. 1 billion in 1985.

per cent foreign equity holding in certain areas, technology imports and the coverage of the MRTP Act.[9] This statement emphasized "continuity with change"[10], and viewed the changes in industrial policy as following on from the "policy and procedural changes .... introduced in 1985 and 1986 under the leadership of Shri Rajiv Gandhi .... The net result of all these changes was that Indian industry grew by an impressive average annual growth rate of 8.5% in the Seventh Plan period."[11]

On the external side, the changes in trade policies constituted a departure from the earlier asymmetric emphasis on import-substitution versus export-promotion. The new policies aimed at increasing competition from foreign producers by: reclassifying products between the banned, restricted and Open General Licence[12] categories to reduce the extent of import controls; a gradual shift from quotas and other non-tariff measures to protectionary tariffs; introducing export promotion schemes such as the establishment of Free Trade Zones, advance licensing to permit imports against the commitment to export, and a new set of incentives to encourage the inflow of technology and foreign capital into export-oriented ventures. The Hussain Committee Report recommended a calibrated reduction

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[9]G.O.I. (1991).

[10]Paragraph 18, G.O.I. (1991).

[11]Paragraph 8, G.O.I. (1991).

[12]The Open General Licence category contained all items not explicitly mentioned in the other lists and thus did not require a licence for importation.

of protection as the infant industries acquired maturity.[13] However, even as late as the end of 1991, little reduction had been effected in either the average rate of tariff or the maximum tariff rate, though restrictions on foreign investment were greatly reduced along with the complete delicensing of industrial activity.

The initiatives contained in the third element of liberalization, the Long Term Fiscal Policy, have been viewed as particularly significant on account of their stated guarantee of continuity, and consequently, their effect on business expectations.[14] These initiatives consisted of : reduction of direct taxes and the exemption of all export earnings from direct taxes, with an emphasis on raising revenues by reducing tax evasion through better enforcement[15]; raising corporate investment allowances and depreciation provisions; introduction of value-added taxes in some sectors, with the attendant benefits of replacing a cascading system of indirect taxes and a reduction in red tape.[16]

The coincidence of the upsurge in growth with liberalization has allowed claims to be made that the alteration in the policy regime was a

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[13]Report of the Committee on Trade Policies (1984).

[14]For instance, Kelkar and Kumar (1990)(pp. 220) state that the LTFP "has had a positive impact on future expectations for returns on investment by its assurance of maintaining continuity".

[15]Direct tax revenues increased inspite of the reduction in personal and corporate income taxes, prompting talk of a Laffer-curve. Subsequent political developments, momentous in themselves, ensured that this was a short-lived phenomenon.

[16]The value-added tax was known as MODVAT, or modified value-added tax.

major determining influence. For instance, a Ministry of Industry publication states that:

"The rapid expansion of the industrial sector in the 1980s was induced by reforms undertaken in trade and industrial policies during the early and mid 1980s."[17]

Few would deny that there was no relevance or connection whatsoever between the changes in policy and the acceleration of industrial growth. It even could be claimed that the elimination of some of the bureaucratic obstacles and the introduction of rationality in the industrial and trade licensing procedures was a necessary precondition to the resurgence of industry.[18] Yet, close examination is required to ascertain whether liberalization or some aspect of it was the main factor in initiating this acceleration.

The ongoing process of liberalization has by no means resulted in a complete metamorphosis of the policy regime, and even the present gamut of controls is wide ranging. However, the broad macroeconomic conjuncture in which this liberalization has been effected has itself been partly shaped by fiscal and monetary policies that were distinct from those in earlier periods.

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[17]Handbook of Industrial Statistics 1991, p. 96.

[18]For instance Ahluwalia (1991) suggests that, "The process of evolution of industrial and trade policies that was started in the late seventies removed some of the policy-made constraints on the supply side.....liberalization.....did provide some flexibility in production which was long overdue and also helped to facilitate technological upgradation in Indian industry." (p. 197)

Experience has illustrated the necessity of exploring the specific historical context of change. In the relatively recent past, the examples of South Korea and Mexico amply illustrate that liberalization and a lowering of trade barriers is neither necessary nor sufficient to introduce competition into the domestic economy and initiate a process of fundamental industrial transformation.[19]

Rationalisation of industrial policy and reduction of the scope of regulation can be expected to increase the flexibility of firms and increase their ability to respond to signals that the market may give. At the same time, the diminution of the restrictions on imports of capital and intermediate goods is likely to encourage the process of investment in stock and the aid upgradation of technology. However, the effects of a gradual reduction of controls on investment and the creation and enhancement of productive capacity should not be expected to be large if the underlying structure of the environment which firms operated in did not correspondingly change .

The process of liberalization in India has been a slow and halting one, and even by the beginning of the 1990s, the extent of the change was not particularly substantial. Certainly, the change in the stance of government and the shift in emphasis towards a removal of regulatory controls had an impact, though the change in terms of practical policy was quite limited in the 1980s. Little of the change in external or internal liberalization took place in the first half of the 1980s, and the major measures of change date after the presentation of the reports of

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[19]Ghosh and Singh (1988) compare the Mexican and Indian experiences. On South Korea, see Lee (1980), Park (1980) and Park (1988). Cardoso and Levy (1988) provide an overview of the Mexican experience.

the Hussain Committee in December 1984 and the Narasimham Committee in 1985. This aspect of the timing of the changes in policy is crucial to an evaluation of the connections between liberalization and growth.

An overview of the 'stagnation' debate

Much of the literature on Indian industrial growth arose in the context of the 'stagnation' debate regarding the deceleration in growth since the mid-sixties. Rather than survey the debate, I list the main categories of explanations provided for the slow growth in the period from 1965 to 1979.[20]

i. Analysts such as Patnaik and Rao (1977) traced the slowdown in industrial growth to a reduction in public investment and a tightening of infrastructural bottlenecks. An extension of this hypothesis emphasises the importance of the composition of investment, distinguishing between the effects of public and private investment, and also between investment in the form of plant and equipment and that involving construction and infrastructure.[21]

ii. Another set of explanations focused on private expenditure. In particular, consumption by households was seen as the key to the varying trends in industrial production. In two different versions, the distribution of incomes, and the deterioration in income distribution

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[20]The most detailed survey, and itself a major contribution to the debate is due to Ahluwalia (1985). A brief survey is available in Krishna (1987) and Bagchi and Banerjee (1984) contains a restatement of the position of several of the original contributors to the discussion.

[21]Ramana (1984).

were perceived to be responsible for the stagnation.[22] It was argued that the resulting narrowness of the domestic market hindered a sustained expansion of industrial output.[23] The burgeoning sales of consumer durables in recent years are seen either as evidence of a highly skewed distribution of incomes or an increasing inequality (by standard definitions) in the two versions of the explanation that relies on income distribution.

Evidence supporting or negating these contentions about the distribution of income is suspect. Compilation of figures pertaining to income distribution is undertaken by employing consumption surveys that are characterised by substantial under-reporting for higher income groups.[24] Indirect evidence such as the very high aggregate savings ratio, with a large and rising component originating from households, and the extent of inflation in real estate and share prices, seems to substantiate the claim that the market for luxury goods and consumer durables expanded to an extent not warranted by per capita income growth.

iii. The third category of explanatory hypotheses invoked changes in the patterns of agricultural production and shifts in the terms of trade between agriculture and industry.[25] The nature and extent of agricultural growth has important consequences for the aggregate

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[22]Nayyar (1978).

[23]Bagchi (1970), among others.

[24]Utsa Patnaik (1986) contains a detailed review of writing on this subject. See also Krishnaji (1984) for a consideration of the issue of income inequality in India.

[25]Raj (1976), Mitra (1977).

supply of important wage goods and for demand for industrial products.

iv. The final category of explanations hold the nature of industrial and trade policy structure responsible for the slowdown.[26]

The limitations of the "stagnation" literature lie primarily in the inadequate econometric testing of these hypotheses in a general enough framework.[27] Support for the various hypotheses has been sought in terms of broad trends in data, rather than a proper econometric framework. The existence of interlinked possibilities with various pathways of influence must be admitted, but the little econometric evidence, where it exists, has been largely concerned with particular hypotheses and involved only partial estimation. While these explanations are considered separately for analytical purposes above, there is a considerable degree of overlap and even mutual reinforcement in terms of influence. It would not be sufficient to refute each hypothesis separately when they may jointly constitute an adequate explanation for the dynamics of industrial production.

In this dissertation, I will attempt to model the dynamics of the industrial sector in a general, encompassing framework, using the background of the 'stagnation' debate. In addition, the impact on industry of variables identified as being of interest by the industry

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[26]Bhagwati and Srinivasan (1975), Ahluwalia (1985).

[27]See Krishna (1987) for a critique. Similar sentiments are expressed by Rakshit (1989) in the context of Indian macro-models.

component of various macro-models will be investigated.[28] Furthermore, this study is directed towards covering as much as possible of the period from 1950-1 to 1988-9, and accounting for not just the most recent phase of industrial development.

In this dissertation, I have sought to identify the forces underlying industrial growth rather potential constraints on industrial development. Consequently, I focus on the determinants of the changes in industrial performance rather than attempt to identify the ex-ante constraints on growth.[29]

Trends in Industrial Production.

While the "retrogression" and "atrophy"[30] of the mid-sixties continued to attract attention and generate debate, a general consensus emerged both within and outside of government in the second half of the eighties that industry had moved on to a phase of high growth. The phrase 'new growth path' was used in government documents to describe the higher rate of growth in National Income in the 1980s, but could equally well have been applied to industrial output.[31]

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[28]Surveys of Indian macroeconometric models can be found in Krishnamurthy and Pandit (1984), Krishna (1987) and the chapter by Marwaha in Bodkin, et al (1991). See also Lahiri, et al (1984), Krishnamurthy, et al (1984), Pandit (1984) and Taylor(1988).

[29]Abhijit Sen (1981) uses a consistency planning model to identify such ex-ante constraints on growth and gain a retrospective view of overall growth in the Indian economy.

[30]The terms are due to Shetty (1978) and Mitra (1977), respectively.

[31]From Economic Survey (1988-89).

The precise estimate of growth is dependent on the particular index utilised - the Index of Industrial Production (IIP), the index derived from Annual Survey of Industries (ASI) or the output figures from National Accounts Statistics (NAS) - due to differences in their coverage and methodology of estimation. As late as the end of the 1980s, doubts had been expressed about the validity of the extent of industrial growth revealed by the revised series of the IIP.[32] Nagaraj (1989) made it clear that the IIP actually understated the extent of growth in the eighties when compared to the NAS estimates.[33] The consensus appears to be that manufacturing output grew at about nine percent per annum in the 1980s. Industry grew substantially faster in the eighties than in the decade and a half previously, and perhaps even more rapidly than the high levels experienced as a result of the Mahalanobis strategy of the Second and Third Five Year Plans from 1956 to 1965.[34]

The precise estimate of the extent of growth depends on the statistical method used in the calculation. To differentiate between the phases of growth in industry in the years since Independence and to independently quantify the extent of the revival, I estimated the following equation recursively using ordinary least squares (RLS):

$$\Delta gdpi_t = \alpha_1 D_1 + \alpha_2 D_2 + \varepsilon_t \qquad \text{(II.1)}$$

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[32]By Chandrashekhar (1988) and Kurien (1989) who, however, did not investigate the statistical procedures adopted in the compilation of the indices.

[33]This echoes the findings of Ahluwalia (1985) and Ray Chaudhuri (1988).

[34]P.C.Mahalanobis, a statistician and planner, was the guiding force behind the heavy industrial emphasis of the Second and Third Five Year Plans.

where D_1 and D_2 are dummy variables for 1950-1 to 1965-6 and 1966-7 to 1988-9 respectively. The measure of output used is the gross domestic product originating in industry (gdpi) measured in 1980-81 prices.[35]

I selected the equation in terms of differences rather than the observationally equivalent form:

$$gdpi_t = \alpha_1 D_1 + \beta_1 D_1 t + \alpha_2 D_2 + \beta_2 D_2 t + \xi_t \qquad \text{(II.2)}$$

The equation in levels implicitly relies on the stationarity of industrial output around a linear trend. Most econometric evidence, albeit in the context of developed economies, suggests that GDP series have non-stationary unit roots.[36] The utilisation of the differenced variable overcomes potential problems of spurious regression.

TABLE II.2: Modelling $gdpi_t$ by RLS: (1950-1 to 1988-9)

Parameter	α_1	α_2
Estimate	0.0621	0.0439
Standard error	0.0059	0.0104

$R^2 = 0.766$.

This equation only serves to provide a measure of growth. Hence, reporting misspecification test statistics does not serve any useful purpose. The standard errors are heteroscedasticity-consistent and provide a range for the estimate of the growth rate.

[35]A list of all sources of data and adjustments made is available in Appendix A. The use of letters in lower case indicates the logarithm of the variable.

[36]See the original study by Nelson and Plosser (1982), and Perron (1988).

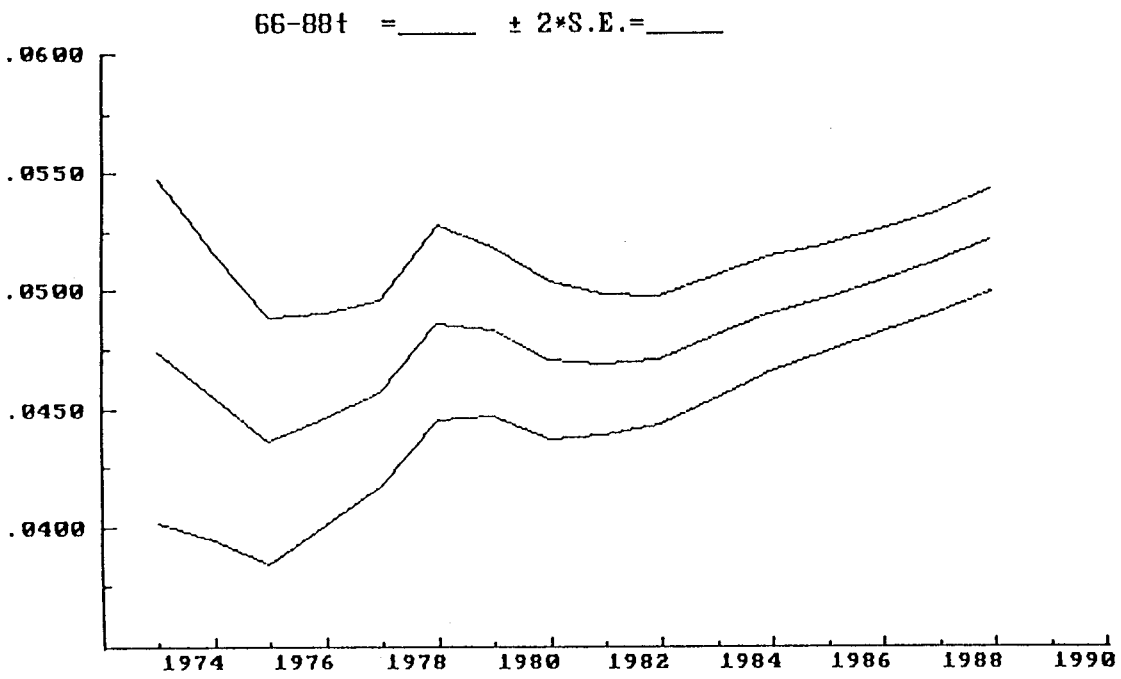

Figure II.i: Recursive sequence of parameter values for α_2

The recursively estimated parameter values for α_2 indicate a gradual rise since 1980-81. An increase in the certainty of the estimate is also displayed.[37] This confirms the widespread belief that industry, and the economy as a whole, were on a "new growth path" in the 1980s. The growth performance since the eighties is best viewed as a distinct break from the previous period of 'stagnation'. However, even a clear departure from past trends is revealed in recursive estimates only as an upward drift in the parameter estimates on account of the weight of past values relative to new ones. Also, the considerable economic

[37]Recursive estimation involves estimating coefficients adding observations one at a time starting from a small number of initial observations. Recursive estimation provides a powerful visual check of parameter constancy. A description of recursive estimation is provided in Doornik and Hendry (1992).

significance of even a small increase in the parameter values which measure the rate of growth should be borne in mind.

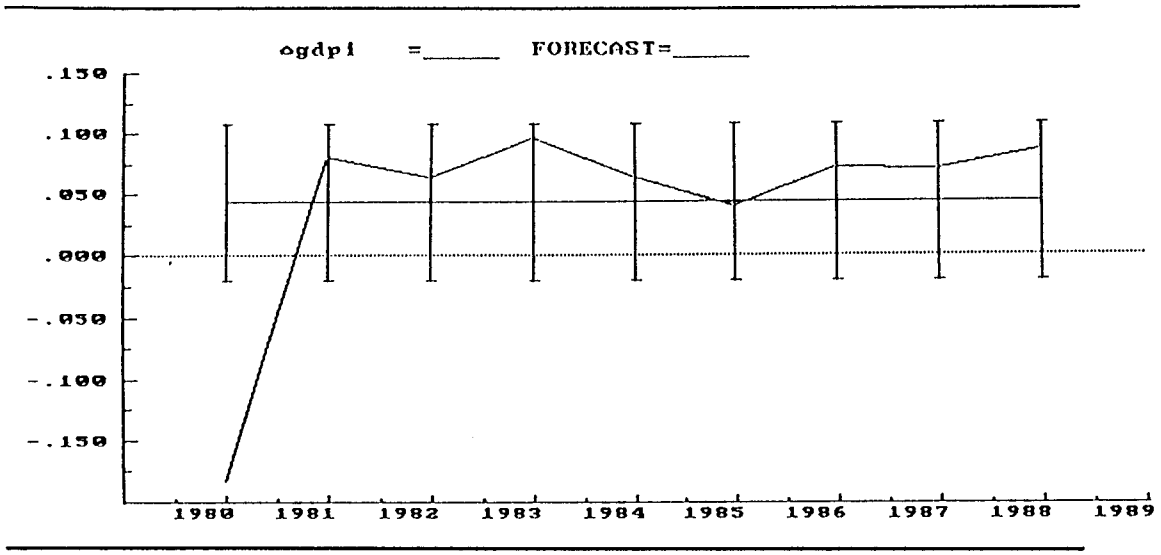

Figure II.ii: Forecast performance of equation II.1.

As an additional check, equation II.1 was estimated using OLS for 1950-51 to 1979-80 and used to provide forecasts for the 1980s assuming that the underlying trend was unaltered. Figure II.ii reveals that the actual values for change in industrial output lie above the predicted values for all but one of the years of the 1980s. Even though these values lie within acceptable bands for forecast performance, the consistent under-prediction clearly indicates a change in the trend rate of growth.

In line with the periodisation suggested by the recursive approach above, I re-estimated the equation using OLS, this time including a third dummy (D_3) for the period 1980-81- 1986-87 and curtailing D_2 at 1979-80.

$$\Delta gdpi_t = \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \varpi_t \qquad \text{(II.3)}$$

TABLE II.3: Modelling $gdpi_t$ by OLS: 1950-89

Parameter	α_1	α_2	α_3
Estimate	0.0621	0.0439	0.0638
Std. error	0.0059	0.0105	0.0089

$R^2 = 0.796$

The estimated values of α_1, α_2 and α_3 provide a measure of the trend rates of growth and indicate a substantial difference between 1966-7 - 1979-80 and 1980-1 - 1988-9. The trend rate of growth for the eighties is not only far in excess of that achieved in the period since the mid-sixties, but surpasses even the high growth experienced at the start of the planning process.[38]

Figures on value-added and the Index of Industrial Production support this conclusion of a substantial increase in the rate of growth in industrial output; the figures on industry-wide production available from UNIDO buttress this conclusion further. While the exact magnitude of growth tends to be different depending on the particular measure chosen, all evidence seems to suggest that the period of stagnation was "decisively reversed" in the 1980s.[39]

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[38]There was a decline in output in 1979-80, essentially due to the severe drought in that year, the effects of which were widespread and felt throughout the economy. This was in addition to the impact of the second oil shock whose effects were felt in India as in the rest of the world.

[39]The term is due to Kelkar and Kumar (1990).

A disaggregated analysis of these output trends, at the 3-digit industry level, and by end use category, provides interesting results.

TABLE II.4: Growth rates of value-added in registered manufacturing (selected industries) at disaggregated level: (percentages)

INDUSTRY GROUP	1959/60 -1965/66	1966/67- 1979/80	1980/81 -1988/89
Food products	0.7	3.8	13.1
Chemicals & chem. prod	10.7	9.1	11.1
Non-metallic mineral prod	7.0	3.0	16.2
Basic metal	15.0	5.1	4.1
Metal products	12.0	2.5	6.8
Non-electric machinery	17.9	7.5	10.3
Rubber products	4.6	4.2	12.3
Electrical machinery	14.7	9.8	20.6
Transport equipment	10.3	4.6	9.1
Miscellaneous[40]	14.2	4.5	20.6
Average (all registered manufacturing.)	**7.6**	**5.5**	**10.4**

Source: Economic Survey

[40]This is not a residual category.

A comparison of the first and last periods provides clear evidence of a shift in the dominant subgroups when the first and last periods are compared. The metal based sectors (basic metals, metal products and non-electrical machinery) which were the fastest growing in the first period dwindle in importance and grew at less than the average in the eighties. The fastest growing sectors in the eighties were electrical machinery, food products, non-metallic mineral products, chemicals and chemical products, rubber and petroleum products, and the far faster than average growth of this, broadly speaking, "bio-chemical" sector dominated the revival of the eighties.

This pattern of dominance of the rubber and petroleum products, and chemicals sub-sector extended to the unregistered sector as well: the unregistered sector as a whole also experienced a revival, but grew at a lower rate than the registered sector. The chemicals and petrochemicals sector attracted an ever larger share of investment at the same time as the metal based industries suffered a diminution in their share of all investment. Therefore, the relative growth experience of the 1980s is likely to continue for these industries. The movement of prices against the metals sector relative to the chemicals sector provides yet another reason to expect future performance to continue to follow the trends established in the 1980s.

TABLE II.5: Manufacturing output growth by end-use.

End use	51/52 - 54/55	55/56 - 59/60	60/61 - 64/65	65/66 - 75/76	81/82 - 88/89
Basic goods	4.7	12.1	10.4	6.5	8.1
Capital goods	9.8	13.1	19.6	2.6	10
Intermediate goods	7.8	6.3	6.9	3.0	5.8
Consumer goods	4.8	4.4	4.9	3.4	6.9
Non-durables				2.8	5.7
Durables				6.2	14.7
General index	5.7	7.2	9.0	4.1	

Source: Economic Survey

A look at the end-use classification of industrial output reveals clearly the phenomenon of consumer durable based growth that has supplanted the earlier expansion driven by investment goods. The reduced dynamism of the basic and investment goods sectors could have a deleterious long-term effect on innovation and productivity improvement, and the increase in the import intensity of overall output as a result of the increasing weight of the most import intensive categories of industrial output may jeopardise the continuation of this process of high growth.

The regional picture is similar to that at the national level, with most states contributing to the recovery from the late seventies on, this

recovery being marked in those states which had a greater deceleration to begin with.[41] While all states experienced declines in industrial output of varying extents in the period of stagnation, the recovery was not quite as universal if figures up to 1985-6 are considered. The spatial concentration of the industry groups that were at the forefront of the recovery exacerbated this tendency towards regionally unbalanced industrial development. The reasons for such a clustering are numerous, and include the obvious ones such as regionally differentiated access to inputs, and state to state differences in fiscal incentives, and will not be considered here.

A final characteristic of the acceleration of the 1980s worth mentioning is the extremely limited generation of employment. The transfer of 'surplus' labour from agriculture to industry has not taken place on the scale anticipated. Even the relatively slow growth in industrial employment in the 1963 - 1979 period was not sustained after 1980, with the trend growth rate declining from 3.2% per annum to -0.33% per annum.[42]

TABLE II.6: Share of work force: (%)

	1951	1960	1970	1980
Industry	9.6	11.6	10.1	11.6

Source: Economic Survey.

[41]Goldar and Seth (1989) point out the anomalous cases of Kerala and Madhya Pradesh among the twelve large states they study, where a continuous secular decline can be observed.

[42]Calculated from UNIDO figures.

The relatively steady share of employment industry has meant that, in aggregate, the tertiary sector has absorbed most of what has been a limited migration out of agriculture. Within manufacturing, private sector employment actually declined from a high of 7.55 m. in 1982 to 7.37 m. in 1987,[43] though aggregate employment was kept relatively steady by the slowly expanding public sector. Explanations would have to invoke a continual shift to less and less labour intensive products and production processes. Kelkar and Kumar (1990) contend, in addition, that the chemicals-oriented processes at the heart of the resurgence are characterised by more inflexible technologies that allow little factor substitution compared to the 'metals' industries.

The limitations of the stagnation literature, and the changed pattern of industrial development in the eighties, in a fast changing policy environment necessitate a fresh approach to account for the pace and pattern of that development.

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[43]Economic Survey. This issue is discussed below.

III

MODELLING STRATEGY, SPECIFICATION SEARCH AND METHODOLOGY GENERALLY

Questions of the methodology of modelling to be adopted in the rest of this thesis are considered here. I begin with a discussion of the relative advantages of and constraints on the degree of disaggregation. What follows is a brief discussion of some important aspects of the econometric methodology that will be used.

The appropriate level of aggregation - tradeoffs and other considerations

In a study of sectoral growth, the unit of analysis and the level of aggregation are of considerable significance in determining the nature and scope of the investigation, and perhaps even the nature of the results obtained and the implications drawn for purposes of policy recommendation. In the context of industry, it is quite clear that the forty years under consideration have seen a considerable change in structure - with major shifts taking place in the fastest growing "leading" sectors; across commodity groups classified by end-use; and across sectors differentiated by size, nature of plant and technology, and capital intensity.

To capture and account for such shifts at a level below that of the aggregate requires a fairly detailed examination of the various component parts of the overall industrial economy. Recognising that such an investigation examining the various individual constituents is beyond the scope of this study, I consider the possible advantages of aggregation and disaggregation to demonstrate that the choice of an aggregated level of analysis may not

be a drawback and may even offer some advantages over a study of the individual components.

In this brief consideration of the issue of aggregation, it is important to bear in mind the objective of this study - identifying the determinants of the dynamics of the Indian industrial economy - and judge the discussion in that light. While any whole can be studied as comprised of the sum of its parts, a case may be made for considering large units, or even looking at the whole as being different from, or greater than, the sum of its parts. The objects of concern are growth and development which have traditionally been studied at a fairly broad level of macro-aggregation and necessarily involve externalities, scale effects, and backward and forward linkages. It will also be quite obvious that most of the concerns mentioned below arise in the context of econometric modelling, estimation, testing and evaluation.

For disaggregation

The case for greater disaggregation is an intuitively appealing one - the more the sub-units are analysed, the better and greater should be the information that can be gained about behaviour at the aggregate level. Quite simply, if the determinants of, and influences on, the behaviour of sub-processes can be isolated and adequately studied, there is little reason why the behaviour of the whole not become made transparent.

More information should facilitate a greater level of detail in analysis, and permit the formulation, testing and evaluation of hypotheses which are founded in the constituent units. A picture of the entirety could well be built up by considering the various sub-units together and the additional information afforded by a disaggregated data-set incorporated and behavioural hypotheses and conjectures formulated appropriately, while

the behaviour of the underlying constituents could also be analysed. In particular, if figures and/or behavioural conjectures - the microfoundations - can be constructed, the macro picture would be enriched, clarified and made transparent. This would require all manner of data compatibility, as well as appropriately defined theoretical concepts that could adequately capture the nature of the micro-agents and combine to form an accurate representation of the macro-aggregates.

Better predictions - specification varied across sub-units

In econometric terms, a greater level of disaggregationis expected to improve the specification of the individual equations. However, it has been demonstrated that an aggregate single equation model will be better specified and out-perform a disaggregated model or even a system of equations.[1] This result essentially derives from the fact that equation errors are multiplicative, and therefore are likely to be greater for a disaggregated model of several micro-equations.

An important qualification to the Grunfeld and Griliches (1960) result is that this result holds only for cases in which the individual sub-model equations have the same specification as the aggregate equation. Varying the specification across sub-units may improve predictive performance.[2]

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[1]Grunfeld and Griliches (1960).

[2]Aigner and Goldfeld (1974).

Better parameter estimation, with corresponding consequences for drawing up policy implications

Eliciting implications for policy is often an important motivation for research, and much time and energy has been devoted to the consideration of this issue in the context of macro-econometric models beginning with the pioneering article by Lucas (1976). The discussion of exogeneity that emerged in response to the "Lucas critique" argues that macro-models are not necessarily useless as a basis for policy analysis and formulation. Suitable model design can avoid the nihilistic impact of this criticism of macro-models.[3] In particular, "weak exogeneity" with respect to the variables in question allows the parameters to be utilised for policy analysis and simulation. Apart from variables that are weakly exogenous for the model, robust estimates of parameters are necessary for meaningful policy prescription. Disaggregation facilitates improved parameter estimation, resulting in an improved foundation for making recommendations for policy.[4]

In favour of aggregation

It would seem that there is little to commend aggregative analysis - as more detail apparently allows a more careful and precise study and evaluation of the issues involved. The only reasons for an agglomerate study, then, should be constraints set by the nature of obtainable figures

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[3]Engle, Hendry and Richard (1983) provide a discussion of "exogeneity" in relation to the Lucas critique. Hendry (1988) and Favero (1989) provide examples of models that successfully counter the Lucas critique.

[4]See the *Introduction* in Barker and Pesaran (1990).

and the availability of appropriate analytical techniques and computational infrastructure. However, there are strong theoretical reasons for aggregated study as well as these considerations of expediency and convenience.

Equation errors

Foremost among the arguments for aggregation are those involving equation errors.[5] In short, the fewer the equations, the less the associated error - both due to misspecification and in estimation. Equation errors are multiplicative, and in the context of a system of equations the overall magnitude of the errors may obviate any gains in transparency and explanatory power accruing through greater detail in analysis.

A further argument in support of more aggregation relies on errors of aggregation.[6] Among other reasons, it is claimed that errors at the more disaggregated level tend to cancel each other out in the process of cumulation. Consequently, the more aggregative the analysis, the greater the likelihood that errors of measurement and misspecification that obtain at the disaggregate level will be reduced.

It appears as if the more disaggregated the analysis, the greater the possibility that the equation will be misspecified. For one, informational requirements are likely to be greater at a greater level of detail, and accounting for behaviour on a subordinate plane of analysis is likely to require carefully considered and properly reasoned theoretical backing.

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[5]Aigner and Goldfeld (1974), Grunfeld and Griliches (1960), Barker and Pesaran (1990).

[6]Perhaps better termed errors of disaggregation. Pesaran, et al (1989) provide a discussion of the errors of (dis)aggregation.

Attaining explanatory power and predictive performance similar to that obtained from more aggregate models is likely to be difficult. To counteract the problems of increased error in a disaggregated model, the individual equations need to be specified differently from the aggregate equation. It is easy to envision instances in which the requisite distinctions in the individual sub-models may not suggest themselves, or, for theoretical or practical reasons, may not exist.

Understandability/comprehensibility/level of detail

Just as there is a case for disaggregation on an intuitive level, it seems that aggregate macro-models offer a discernible advantage in accessibility and transparency.[7] In complex systems of equations, the effects of changes, such as external sucks or altered values or structural parameters, for instance, are often hard to trace. It is difficult to isolate transmission mechanisms and make distinctions between primary effects and second- and later-round changes. In an aggregate model, of which a single equation model is the logical extreme, it is generally easy to estimate the qualitative impact of change, and quantitative measures such as multipliers are also considerably easier to estimate.

Structural parameters in equation systems cannot always be estimated.[8] Reduced or final form estimates are frequently incomprehensible in terms

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[7]Here, a distinction should be made between large scale macro-econometric models such as the Treasury model, the LBS model, the NIESR model and several others in the context of the U.K., and "small" macro-models that focus on certain key areas. Wallis (1989) provides a survey of macro-models, and Klein, et al (1991) is a history of macro-model building. Small macro-models are discussed by Muet in Malgrange and Muet (1985).

[8]A good, up to date dicussion of such concerns can be found in Pindyck and Rubinfield (1991) Ch. 11.

of theory, and they reflect a combination of several effects that may prove difficult to unravel and isolate. Aggregate models are not usually handicapped by such features, and typically facilitate comprehensibility and easy interpretation and allow the direct application of theory.

These concerns and distinctions are somewhat different from those frequently made between "simple" and "complex" modes of analysis, or indeed between "abstract" models and "concrete" reality.[9] Any model can be viewed as an abstract characterisation of a concrete reality that focuses on some area of interest or concern; such an abstraction need not be simple to cast a revealing light on reality. At the same time, a simpler model that adequately characterises the concrete reality should be preferred to a complex abstraction. In statistician's terminology, this can be captured in terms of the adequacy of the assumed model in capturing the features of the true data generating process (DGP). If a simpler model adequately describes the DGP, it is preferred.

The principle of simplicity and/or parsimony

The linking of model superiority to simplicity has been formalized in terms of "the simplicity postulate".[10] The philosophical principle of Occam's Razor can be related to this discussion of desirable model features - simpler is better.[11] If the more aggregative model is able to provide an

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[9]The latter is a distinction particularly made in the Marxist tradition, most notably in Lenin (1911). Cohen (1978) provides a more modern discussion.

[10]Jeffreys (1967). This principle is discussed by Zellner (1986).

[11]The notion of simplicity of a model has been related to its degree of falsifiability by Popper (1934). In this context too, a more aggregated model is more likely to facilitate falsification of propositions.

adequate account of the features under investigation, the verdict is clearly in its favour; if the more disaggregated model can offer insights not afforded by the 'simpler' model, the choice is less clear cut.

In the context of econometric modelling, this concern for simplicity finds a voice in terms of the Hendry/LSE methodology in which a parsimonious representation is seen as one of the requirements for model congruency.[12] Here parsimony is considered along with encompassing, namely the ability to account for the results of rival models, as a criterion for model adequacy; the best model is one that can encompass rival models and is a more parsimonious representation of the data. The trade-off between explanatory power and the number of variables employed in estimation has been formally considered and is embodied in this methodology,[13] and such considerations can be extended to the comparison between aggregate and disaggregated models.

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[12]While Sargan (1964) is often viewed as the first article that embodies this methodology, the first clear statement can be found in Davidson, et al (1978). Spanos (1986), Hendry (1988), and Hendry, et al (1990) adumbrate this methodological viewpoint. Gilbert (1989) and Darnell and Evans (1990) review this methodology and place it in a historical context.

[13]A measure that is used to measure model performance when explanatory power declines with a reduced number of explanatory variables is the Schwarz Criterion, which adjusts the R^2 for the number of independent variables. See Hendry (1988) for an exposition.

I shall use the Schwarz criterion to determine the optimal level of reduction to a parsimonious model, in combination with sequential F-tests of significance.

Macro-phenomena without adequate micro-foundations?

Aggregative models can sometimes present an escape from a situation in which the informational and theoretical needs of a disaggregated model are too great to be properly taken into account. There may yet be other situations where interactions between the micro-units may produce effects that can only be reckoned with at an aggregative level. The literature on externalities is extensive, and recent research seems to suggest that there are possibly effects that can only be captured at an aggregate level in the context of growth.[14]

The use of aggregate models may be motivated by the existence of macro-phenomena that do not have adequate micro-foundations. This "non-existence" of microfoundations is more a reflection of the absence of theoretical development and research and, in many cases, insufficiently revelatory data than anything else. It is possible that theoretical developments and their empirical application may permit a more disaggregated approach in future study.

The nature of the available statistics

Finally, and perhaps most critically, the choice of the level of aggregation may be determined more by the availability of figures than any other single factor. Not only are statistics more readily available at the aggregate

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[14]References to the literature on sources of endogenous growth following in the tradition of Romer (1986, 1990), Lucas (1988) and Scott (1989) are provided in the chapter on productivity and the supply-side. These studies deal with the growth of whole economies; in the context of the industrial sector, it is very possible that accounting for such sources of growth at a sectoral plane will be difficult and may even be impossible to accomplish at the sub-sectoral level.

level, they are usually more reliable and prone to less error in measurement.[15] Errors in the estimation of constituent elements are carried over to the sum; however, errors are likely to cancel each other in the the process of conglomeration, and the figure for the sum may be subject to percentage errors.[16] Longer runs of data are usually available for greater aggregation, and the choice of the level of aggregation may be dictated by the need for greater degrees of freedom.

In some cases, the official grouping of the disaggregated data may be of limited analytical value because of the incompatibility of theoretical concepts and the available classification.[17] Official categories are more likely to have been determined by considerations of economy and convenience than a desire to support the cause of economic research.

Time-series econometrics - the issues involved

This thesis is concerned with the econometric analysis of the dynamic aspects of industrial performance. Clearly, time series econometrics is at the forefront of this research, and any remarks that follow should be interpreted with this in mind. Some cross-sectional data on Indian industry do exist, but their reliability is questionable, and therefore panel

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[15]The adoption of the UNSNA, for instance, has introduced a certain element of uniformity in conceptual and practical methods in estimating macro-aggregates across the world.

[16]Figures on GNP and other macro-aggregates compiled and published by the CSO are seen as being more reliable than various figures on the component parts of the industrial sector, such as the ASI. Also, there has been substantial debate about the appropriate measure of industrial growth in India. Ahluwalia (1985) and (1991), Chandrashekhar (1988) and Nagaraj (1989) provide recent summaries. A detailed discussion of the choice of sources of data is provided in the Appendix.

[17]Sterner in Barker and Pesaran (1990) provides an interesting example.

data techniques will not be used in this dissertation.[18] Also, the theory of modelling unit root time series in a panel data framework has not been sufficiently developed. For instance, the distributions of test statistics pertinent to panels are not known.

The philosophy/methodology of econometric modelling

The approach to econometric modelling that employed in this thesis is one that has enjoyed considerable empirical success, particularly since the pathbreaking study of the consumption function in Davidson, Hendry, Srba and Yeo (1978).[19] Often described as general-to-specific modelling, this econometric methodology attempts to develop a congruent representation that characterises the data generation process or DGP. Staring with the most general specification suggested by theory, a process of reduction is used to obtain a parsimonious representation of the data generation process. Extensive testing of the specification, incorporation of model dynamics, and evaluation of predictive accuracy are also an intrinsic part of this approach.[20]

The research methodology and modelling strategy utilised below draws on what has come to be known as the "LSE and British approach to time

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[18]Ahluwalia (1991) has attempted to utilise the panel data from the ASI to study productivity and growth in industry.

[19]While there are several examples of research incorporating and embodying this methodological perspective, Hendry, et al (1990) assesses the impact DHSY (1978) has had on the way econometrics is practised, and describes the continuing evolution of this methodology.

[20]Pre-testing and evaluation of the nature of the economic series being modelled is another important facet of this methodology.

series econometrics".[21] This tradition, developed and popularised by various statisticians, economists and econometricians who either taught, or were taught, at the London School of Economics relies on observed data features as a guide to economic modelling. Economic theory provides a menu of variables that may be related in the long-run rather than a set of a priori constraints on the dynamic adjustment mechanism. Frequently, the model involves an error-correction mechanism that combines both the equilibrium long-run features and the out-of-equilibrium short-run behaviour.

In this approach, the variables of interest are those which theory suggests are significant. The precise functional form of the model is not imposed by theoretical priors, but gleaned from the properties of the data. The data tell their own story, which is agnostic between different theoretical explanations of the short-run.

In this search for an adequate functional specification, emphasis is placed on mis-specification testing in attempting to derive a "congruent" model. Keeping in mind the time series and other data characteristics, an unrestricted general model is constructed, and by a process of sequential reduction, with mis-specification testing at each stage, simplified to a validly conditioned parsimonious model. In this general-to-simple approach, the attempt is ultimately to construct a model that adequately explains the data features with the smallest possible set of variables.[22] This safeguards against different researchers arriving at different results to

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[21] Gilbert (1989) paper entitled "LSE and the British Approach to Time-Series Econometrics" in OEP Special Issue on the History and Methodology of Econometrics.

[22] See Gilbert (1986) on reduction.

account for the same phenomenon, a probable outcome with the reverse approach, in which model failure is sought to be corrected by subsequent alteration. As long as the search begins with the same variables of interest, the process of reduction is likely to lead to the same parsimonious restricted model. A reduced number of explanatory variables is desirable for manageability and interpretability; parsimony is also important if forecasting is to be at all meaningful.

With encompassing (providing an explanation of the results of rival models) being a criterion for congruency, it is usually the case that purely time series models of the Box-Jenkins type will be avoided, and that the attempt to account for the results of theory based models will necessarily involve the use of economic theory in specifying the model.[23] The modelling strategy is tied together by the principle of 'encompassing', which "forms a major plank in the LSE defence against the arbitrariness charge".[24] Encompassing implies an ability not only to perform better than rival non-nested models, but also to account for the inadequacy or inferiority of the rival model. This vital facet of the modelling strategy can be traced to an attempt to stress the economic content and significance of such models when challenged by the 'black-box' models of the Box-Jenkins type, and is the final test of the model, and implicitly so, the underlying strategy. However, economic theory is used to guide variable selection, and restrictions are sometimes placed on values of parameters, or the functional form being considered on certain theoretical grounds. For the most part, there is no formal economic model that is sought to be

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[23]Gilbert (1989) emphasizes the importance of encompassing in staving off criticism on grounds of economic philistinism.

[24]Gilbert (1989).

evaluated and tested; the argument against the use of a well-defined economic model being the view that the working of economic processes is not well known enough.[25] The desire to start with the most general form possible in several cases implies that economic theory cannot always be used to pre-specify the equation or model being estimated.[26]

An exposition of the "theory of reduction"[27]

A vital element of the LSE/Hendry methodology is the reduction of the general specification to a specific congruent model. However, the principles on which the reduction sequence is to be based have not been made explicit. It is important that the process of reduction is systematized and made transparent, so that criticism alleging data mining is countered and avoided.[28] At the same time, the proponents of this methodology have sought to ensure the easy replicability of results of modelling exercises, along the lines suggested by Leamer,[29] and it should be clear that such replication of results is not always possible without the reduction sequence having been made explicit.

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[25]Davidson and Hendry (1981) p. 191 put forward this view.

[26]For instance, Hendry (1979) pp. 226, states, "Until the model adequately characterises the data generation process, it seems rather pointless trying to test hypotheses of interest in economic theory".

[27]Hendry et al (1990).

[28]Darnell and Evans (1990) are particularly scathing in their attack, and they have collected a list of similar pejorative viewpoints on "reduction".

[29]Leamer (1983).

Perhaps the "theory of reduction" has not been made explicit due to the fact that the subjective judgement of the modeller is an important element in determining the precise route toward the final specification. In the absence of such a systematic exposition of the theory of reduction there is the necessity of presenting an explicit reduction sequence, stating at each step the reason for the particular reduction.

The importance of an explicit search procedure

The title of Leamer's 1983 paper "Let's take the con out of econometrics", is an excellent guide to the nature of its contents. Leamer focuses on elements such as pre-test bias which determine the shape of the final specification that is presented as a result of research. Leamer presents a theory of search procedures, then suggests that the search procedure be made explicit so that econometrics gains a greater degree of respectability and a larger number of believers. This espousal of openness and transparency is of special significance in the context of the reduction sequence followed in general-to-specific modelling, and in ensuring the replicability of model results.

Leamer's other major contribution relates to the interpretation and presentation of the results of model estimation, and he urges caution and circumspection in drawing implications on the basis of econometric results. Too much is frequently claimed on the basis of final specifications, and it is likely that greater attention to the search procedure will reduce the often undue emphasis placed on the final specification of the modelled relationships.

The importance and significance of causality

Modelling reflects an attempt to unravel relationships between different economic variables. Bearing in mind that correlation does not imply causation, it becomes necessary to perform various other tests on variables and their predicated relationship to each other before any statements about causation can be made. Causality is often extremely difficult to establish in practice, it being far easier to establish non-causality. Tests of causation are related to concepts of exogeneity, but such tests are frequently inconclusive, and may suggest that variables are interdependent and influence each other simultaneously.[30]

A factor that complicates notions of causality is temporal aggregation of data. Notions of causation typically exclude simultaneous events, and seem to require a prior sequence of events influencing a later one. Of course, this is quite possibly occurring on a time-scale smaller than the one being used to measure the variables employed in the modelling exercise,[31] with the consequence that the causal relation between the variables is altered to one of simultaneity by the process of temporal aggregation.

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[30] An example is the test for Granger non-causality, which was really meant to test for feedbacks rather than causality. There are also the related tests of exogeneity, elaborated in Engle, et al (1983), which also distinguishes between alternative concepts of exogeneity. Cooley and LeRoy (1985) demonstrate that Granger non-causality is not the same thing as econometric exogeneity as suggested by Sims (1972). Hendry (1988) provides an explanation in the context of the modelling program PC-GIVE.

[31] As mentioned earlier, it is very possible that data is simply not available for the ideal time spans or periodicity. Here again is a case of available data not conforming to the requisite analytical norm.

Time Series Properties - Treatment of integrated series[32]

In line with what has become accepted procedure for econometric modelling, the time series properties of the relevant series were investigated, in particular to discover orders of integration, and to check for the presence of unit roots in the data.[33] Following the pioneering work of Nelson and Plosser,[34] who showed that several macroeconomic time series were non-stationary and integrated of order 1, rather than the stationary I(0) variables standard econometric techniques had been designed for, it has become customary to check model variables for non-stationarity.

A series is said to be integrated of order d if it requires to be differenced d times to render it stationary, when differencing it d'< d times does not reduce it to stationarity. More formally,

a series $x_t \sim I(d)$

iff $(1 - L)^d x_t$ has a stationary, invertible autoregressive moving average (ARMA) representation. (L is the lag operator.)

In general, a linear combination of I(0) and I(1) variables is dominated by I(1) variables. The implication this has for regression strategy is that the explanatory variables must be such that the conditional distribution underlying the regression analysis is stationary - if the dependent variable is I(0), the explanatory variables must be jointly stationary.

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[32]Aoki (1988) looks at aggregation and its impact on cointegration. See also Granger (1988), the result due to Pesaran and Pesaran in Barker and Pesaran (1990) and Hylleberg and Mizon (1989).

[33]Views expressed by Phillips and Ouliaris (1988), Aoki (1988).

[34]Nelson and Plosser (1982).

One way of achieving this stationarity is to difference the variables until they are rendered stationary. However, this has been shown to be neither necessary nor helpful - not necessary, as only the underlying conditional distribution, rather than each variable separately, need be stationary; and not helpful, as this involves a substantial loss of information about the relation between levels of the variables in the long-run, though this information is the subject of much economic theory.[35]

In testing for stationarity, a variety of different statistics have been suggested. Hylleberg and Mizon suggest a decomposition of a variable into a deterministic trend, a stochastic trend and a stationary random vector.[36] Given the difficulty in discriminating between deterministic and stochastic trends, they suggest that an attempt be made to model all of the possible different components of the variables.

Sargan and Bhargava (1983) suggest the use of the Cointegrating Regression Durbin-Watson (CRDW) test. The regression

$$y_t = \alpha' x_t + u_t$$

is run first, where α is possibly the cointegrating vector. The null hypothesis that

$$u_t = u_{t-1} + e_t ; \quad e_t \sim IN(0, \sigma^2_e)$$

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[35]Hendry and Mizon (1978).

[36]Hylleberg and Mizon (1989). They also suggest the use of stochastic and deterministic seasonals, but here we are dealing with annual data.

is then evaluated against the alternative that the errors follow a stationary first order Markov process using the standard Durbin-Watson statistic with the critical values generated by Sargan and Bhargava.[37]

The Dickey-Fuller (DF) test uses the t-values from the regression

$$\Delta u_t = \pi u_{t-1} + \nu_t; \quad \nu_t \sim IN(0, \sigma^2\nu)$$ [38]

evaluated with the critical values provided by Dickey and Fuller.[39] The Augmented Dickey-Fuller (ADF) test allows for the presence of lagged dependent variables in the regression.[40]

The DF and ADF tests are sensitive to the exact features of the random walk - whether it incorporates a drift, or a trend, or both.[41] Following the advice of Said and Dickey (1984), care was taken not to include too many lags in the Augmented Dickey-Fuller regressions, and a maximum of two lags were used in estimation for the annual series. Keeping in mind the low power of the tests, and the difficulty in discriminating between a

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[37]Sargan and Bhargava (1983).

[38]Δ is the difference operator. For instance,

$$\Delta u_t = u_t - u_{t-1}.$$

[39]Dickey and Fuller (1979, 1981).

[40]The number of lags allowed in the ADF tests are related to the order of autoregression; Said and Dickey (1984) caution against the use of excessive lags when the order of the autoregressive process is unknown.

[41]See Schmidt and Phillips (1992).

stochastic and deterministic trend, it is often difficult to come to a firm conclusion as to the non-existence of a unit root.[42]

Cointegration Testing

With the recognition that many economic time series are not in fact the stationary variables which early econometric techniques had been designed for, there has been a growing literature directed towards the theory and testing of economic relationships involving such variables. Models that involve sets of variables that are individually non-stationary, but which jointly form linear combinations that are stationary, that is, cointegrated variables, can be evaluated with standard econometric tests.[43] A significant element of research on cointegration is concerned with establishing the validity of statistical procedures and distributional theory for cointegrated variables, obviating the need for fresh results for models involving non-stationary variables.

A set of variables is said to be cointegrated when a linear combination of these variables, themselves not stationary, is stationary. Cointegration can be defined as follows:

N series in the vector x_t are cointegrated of order (d,b), $[x_t \sim CI(d,b)]$,

if all N series are integrated of order d, $[x_{it} \sim I(d)]$

and there exists a linear combination of the N series $z_t = \alpha' x_t$

such that $z_t = \alpha' x_t \sim I(d-b)$.

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[42]Caution in interpreting the CRDW, the DF and ADF statistics is urged by Granger (1986) and Jenkinson (1986), among others.

[43]Sims, et al (1990) demonstrate the possibility of using standard tests for cointegrated variables that are individually non-stationary.

Cointegration of economic time series allows a long-run interpretation of the relationship between the variables; such a long-run relationship would necessarily require that the series be characterised by the same order of integration. An error correction mechanism (ECM) facilitates the representation of both long-run equilibrium and out-of-equilibrium short-run adjustment behaviour of time series variables; such an interpretation also avoids criticism to which a purely equilibrium approach would be open. With the development of the Johansen Maximum Likelihood Method[44], all of the different sets of cointegrating vectors can be identified, allowing a number of different relationships to be investigated. The utilisation of cointegration analysis should be viewed not so much as a question of choice as one dictated by the time series characteristics of the variables being modelled; such an investigation of time series features is an essential preliminary to econometric modelling.

As a first step in testing for the existence of cointegrating vectors, no dynamics were included in a regression of the series in levels to investigate for the existence of cointegration. Such a specification has been shown to have the property of yielding super-consistent estimates of the parameters of the cointegrating vector, as the biases will be of order 1/T rather than $\sqrt{(1/T)}$, even though the least squares estimators of the cointegrating vector are not asymptotically normal in distribution.[45]

Tests for cointegration are simply the tests for stationarity described above, as applied to the residuals from the regression in levels. The power of

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[44]Johansen (1988). Also see Johansen (1992).

[45]Stock (1987) provides the super-consistency result. Phillips and Durlauf (1986) derive the asymptotic properties of the estimators.

such tests being low, and the limiting distributions of the test statistics being non-normal, caution is once again necessary in accepting the null that the vectors do not cointegrate.[46]

Interpretation of ECMs

The treatment of time series in the context of their orders of integration has led to the development of the theory of cointegrating vectors and the use of error correction mechanisms (ECMs) in modelling time series with different orders of integration.[47] As Mizon and Hylleberg (1989) demonstrate, an ECM is but one of a number of interpretations that can be attached to a set of cointegrating vectors.

As the Granger Representation Theorem has shown, and more recent work has reiterated, cointegrated variables can always be represented as an Error Correction Mechanism (ECM), and vice versa.

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[46]This point is made by Clements (1989) who cites the doubts expressed by Jenkinson (1986) regarding the acceptance of the hypothesis of non-cointegration on the basis of the CRDW, DF and ADF statistics in testing for the existence of a neoclassical labour demand model.

The ADF test on the residuals of the static regression

$$y_t = \phi_0 + \phi_1 z_t + \omega_t$$

corresponds to the COMFAC test ($\gamma_2 = 0$ if $\gamma_1 = 1$, when κ is known) for

$$\Delta y_t = \gamma_0 + \gamma_1 \Delta z_t + \gamma_2 (y - \kappa z)_{t-1} + \varepsilon_t.$$

See Hendry, et al (1991).

[47]Engle and Granger (1987) prove that every cointegrating vector has a corresponding ECM representation, and vice versa.

In addition to an ECM: $[\ A(L)(1-L)\ x_t = -\gamma\ (\alpha' x_{t-1}) + e_t\ ]$,
a cointegrating vector can be reparametrised to yield several other observationally equivalent forms.[48]

This isomorphism allows the cointegrated variables to be represented in several different but observationally equivalent ways, which have different relative advantages in terms of ease of computation and interpretability.[49]

The EC specification, the first application of which has been traced to Sargan's 1964 Colston paper,[50] has become particularly widespread since it was employed in the influential study of the consumption function by Davidson, et al.[51] With the rationalisation in terms of the Granger Representation Theorem behind us, the EC form becomes attractive as a strategy for modelling the cointegrated variables.

The attractiveness of the ECM in estimating structural models stems from its interpretability in terms of economic theory, and the combination of short-run dynamics and long-run equilibrium that it embodies. It facilitates the application of theory whilst remaining faithful to the data information. ECMs have also been interpreted as partial adjustment models in the context of intertemporal optimization in a rational

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[48]Hylleberg and Mizon (1989) provide several examples.

[49]Banerjee, et al, (1988) in suggesting an eclectic approach to take advantage of the different formulations, highlight the advantages and drawbacks of the Bewley Representation and the Engle-Granger 2-stage estimator.

[50]Gilbert (1989) draws attention to this aspect of Sargan(1964), which is important as one of the earliest embodying the LSE tradition.

[51]Davidson, et al (1978).

expectations and adjustment cost framework, linking optimization theory with empirical testing.[52]

The error correction term is a dynamic adjustment that keeps the variables from drifting too far out of 'equilibrium', and in that sense has a readily interpretable significance. Of special import, given the small span of annual data on Indian industry, is the fact that it "performs well" in small samples.[53] It bears reiteration here that the ECM is simple to estimate - OLS on the static regression provides superconsistent estimates of α'.

The Johansen Maximum Likelihood procedure

In general, more than one cointegrating vector may exist between a set of vectors, and one of the advantages of the Johansen Maximum Likelihood Estimator is the fact that all of the cointegrating vectors are calculated.[54] Use of this method allows restrictions on the cointegrating vectors to be tested easily, and the associated test statistics have well-defined and invariant limiting distributions.[55]

For an n-vector process x_t, which is integrated of order one; so that Δx_t has the Wold decomposition $\Delta x_t = H(L)\mu_t$ (where $H(L) = \Sigma H_i(L^i)$, $\mu_t \sim ID(0, \Sigma)$, and L is the lag operator); if there are r cointegrating relationships, then

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[52]Nickell (1985). Dolado, et al (1991) provide analytical support and Monte-Carlo evidence of the links between Euler equation models and ECMs.

[53]The phrase is from Hylleberg and Mizon (1989).

[54]Johansen (1988).

[55]Clements (1989) discusses the relative advantages of different methods of estimating the cointegrating vector.

$H(1) = \Sigma H_i$ has rank r, and there exists an ECM representation given by

$$B(L)\,\Delta x_t = \Pi x_{t-1} + \nu_t$$

where $\Pi = \alpha\beta'$ and α and β are $n \times r$ of rank r.[56]

The Johansen procedure estimates the rank of α and β in the VAR above, which provides an estimate of r. The hypothesis of cointegration is formulated as the hypothesis of less than full rank of the long-run impact matrix $\Pi = \alpha\beta'$. The cointegration vectors β are the eigenvectors of a positive-definite matrix, and the corresponding eigenvalues μ_i provide test statistics based on $T \log (1-\mu_i)$. The number of terms that are not rejected gives the number of cointegrating combinations of x_t.[57]

The Engle-Granger Two-Step Procedure

Granger and Engle suggest the use of a two-step procedure to estimate the ECM. In the first step, the cointegrating regression is estimated using OLS, as above, to obtain a long-run equilibrium relationship between variables in levels. The vector of residuals from this long-run equation, a stationary, linear combination of the variables in levels, is then included as a regressor in a short-run equation involving dynamics. A general-to-simple search using the theory of sequential reduction is then used to obtain a parsimonious representation to account for the dynamics in terms of the differences of the variables (which are now I(0) and stationary).

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[56]The definition above relies on Hendry, et al (1990).

[57]Johansen (1988), Johansen and Juselius (1990) and Johansen (1992) outline the procedure and provide applications and provide tables of critical values for the asymptotic test statistics.

The complete omission of dynamics in the first-stage and the imposition of the cross-equation restrictions via the inclusion of the EC term in the second stage are founded on asymptotic efficiency and consistency results. While the estimation of the cointegrating vectors is super-consistent in this approach, the small sample bias may be large, and the finite sample bias may even increase with the sample size in the case of unit roots.[58]

Such a procedure provides a test of the hypothesis of cointegration, as well as providing a dynamic model for the variables of interest. The t-statistic for the error correction term (here, the residuals from the levels equation) provides a test for the null of non-cointegration. Also, if the residual term is to be given an error correction interpretation, the sign of the coefficient on this term should be negative.

Cointegration testing may demonstrate the need for including other variables in the model; in the terminology of the LSE tradition, it is a test of whether the model from which reductions were made is general enough. For instance, Hall and Drobny (1989) establish the need for adding a tax variable in their search for a cointegrating long-run specification for non-durable consumption; they stress that any variable required for cointegration should not be dropped in the subsequent search for dynamics.

Parameter stability, particularly of the coefficient on the EC term, has been suggested as a check on the constancy of the cointegration relationship

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[58]Banerjee, et al (1986) and Banerjee and Dolado (1988) provide evidence of small sample bias using Monte Carlo methods. Abadir (1993) demonstrates analytically that the bias could increase with size for finite samples.

over time.[59] If any sort of equilibrium interpretation is to be attached to the observation of cointegration, such a close and robust linkage of the relevant variables becomes necessary. Recursive estimation permits an examination of parameter constancy, and can easily be applied to the coefficient of the EC term, particularly if graphical methods are used. Recursive methods also facilitate an evaluation of within-sample forecast performance, and recursive methods will be adopted wherever possible. In some instances, parameter values vary over time, and the use of recursive techniques could reveal the extent and nature of the impact of regime changes.[60]

Recursive techniques offer a method of model evaluation that is fairly easy to implement. Other misspecification test statistics that will be reported below are -

the Durbin Watson test for autocorrelated residuals (DW);

the Lagrange Multiplier test for autocorrelated residuals (LM);

the Autoregressive Conditional Heteroscedasticity test (ARCH) or Lagrange Multiplier test for autocorrelated squared residuals;

the Jarque and Bera test for normality on the residuals;

the White test for heteroscedasticity;

and the Regression Specification Lagrange Multiplier (RESET) test for omitted variables.[61]

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[59]Clements (1989) uses recursive estimation of several parameter and test-statistics to establish the existence of a structural break, and demonstrate how the correctness of the estimated order of integration can be established.

[60]The discussion of constancy and invariance in Hendry, et al (1990) distinguishes between the two concepts alluded to in the context of recursive testing above.

[61]A fuller decription of the tests can be found in Hendry (1989).

Small samples, annual data

The data that I employ are entirely annual figures, and the sample size is small, at best.[62] Clearly there is a need to interpret results carefully, given the nature of the data at our disposal. The critical values for cointegration, in particular, are sensitive to the existence of drift, and the power of such tests is difficult to determine. Even customised, Monte-Carlo generated, critical values are not always reliable, given the sensitivity of the ADF and LR tests to functional forms and parameter values.[63]

The existence of finite sample bias in tests of unit roots implies that the tests need to be interpreted carefully. Graphical analysis serves as a useful aid to interpretation in this regard, at least in terms of identifying stationarity. The CRDW test will be used only as a preliminary method of identifying the order of integration, keeping in mind the low power of this test. In the estimation of a price equation for industry, for instance, graphing the activity term serves to identify the nature of the series as stationary.

As residual based-tests of cointegration are tests for unit roots, they too are subject to the same qualifications, and require careful interpretation in the small samples of data available. In testing for cointegration in the following chapters, I will use the Johansen Maximum Likelihood Method, which is also not free of finite sample bias. Reimers (1991) suggests that the Johansen method over-rejects in small samples when the null is true.

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[62]The span of data varies from 1950-88 to 1971-1987.

[63]See Blangiewicz and Charemza (1990) for a pessimistic view of cointegration testing in small samples.

This calls for care in interpreting the critical values of the test statistics based on eigenvalues derived from the VAR.[64]

Johansen (1992) discusses the problems in formalising the MLE procedure of determining cointegration in integrated systems. He suggests that "the determination of cointegration rank should be also be based on the interpretation of the estimated cointegrating relations",[65] and provides an example where the choice of the eigenvector was made on the basis of the simple description of the data that it facilitated.

Establishing cointegration and identifying the cointegrating vector is not an easy task even when the sample size is large.[66] The conclusion of cointegration is ultimately reliant on the performance of the EC term in the estimated equation. In the light of the Granger Representation Theorem, this represents a way of establishing cointegration. Accordingly, in the econometric analysis that follows below, testing for cointegration will rely on the maximum likelihood methods based on the VAR, and will be confirmed by the performance of the error-correction term in the final specification.

Ultimately, the value of cointegration analysis derives from its ability to aid congruent estimation and prevent mis-specification in the modelling of integrated series. By employing stationary variables, or stationary

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[64]See the discussion of finite sample properties in Banerjee, et al (1993) pp. 285-6, and Gonzalo (1990).

[65]Johansen (1992) p. 396.

[66]For instance, see Banerjee, et al (1993) p. 236 where the hypothesis of cointegration is rejected on the basis of one set of tests and accepted on the basis of the performance of the EC term.

combinations of variables that are not themselves stationary, the integrity of the models developed will be insured.

Overall, recursive testing, and within sample and out of sample forecasting, even in the small samples considered, will be used to justify the use of cointegration methods in estimating economic relationships of interest in this thesis. For instance, even in the sample of twenty years from 1968 to 1987 in the case of the price equation, an out of sample forecast period of three years will be used in addition to recursive tests within sample to establish parameter stability and the robustness of the model specification.

A consolation, minor as it may seem, can be derived from the belief that the span of data is more important than just the number of observations in providing a foundation for modelling.[67] Campbell and Perron (1991) suggest that the span of the observations is particularly significant in the context of cointegration, which concerns long-run relationships between economic variables. Obviously, the availability of monthly or quarterly figures for industrial production and prices over the same span will facilitate a more thorough econometric investigation than one employing only annual statistics. The availability of a certain number of observations is clearly preferable to the same number of observations for a shorter span. The recent trend towards the compilation and publication of quarterly statistics by the Reserve Bank of India should provide, in time, an improved basis for econometric research.

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[67]See Kennedy (1992) and Campbell and Perron (1991).

The issue of multicollinearity

Identification of the cointegrating combination of a set of regressors that are I(1) offers a method of overcoming potentially serious collinearity problems. Conditioning on the cointegrating combination, possibly with a lag, provides an avenue of overcoming the usual problems posed by multicollinearity. Use of the cointegrating vector is similar to employing a transformation to near-orthogonality, which is a way of ensuring that multicollinearity is avoided.[68]

This does imply that the static long-run equation often used as a means of identifying the cointegrating vector is ill-suited to assessing the significance of variables that are not part of the cointegrating combination. Estimation of the long-run equation without dynamics, accordingly, will only be used as a further pointer to the existence of cointegration to validate the results that the Johansen Maximum Likelihood method may furnish. Exploration of the significance of variables that are not part of the cointegrating combination is best accomplished in an equation that employs an error-correction term to capture the interaction of the cointegrating variables.

In general terms, a clue to the possible existence collinearity is provided by the matrix of the coefficients of correlation between the model variables. If the correlation coefficients are high, they point to the need for careful interpretation of an equation involving those variables. A transformation such as differencing, or subtracting one variable from another offer ways of eliminating the potentially destructive effects of multicollinearity.

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[68]See Banerjee, et al (1993) p. 307.

Ideally, the transformation should be interpretable in economic terms, as in the case of an error correction term. Keeping in mind this possibility of collinearity, the static long-run equation will not be used as a basis for determining the significance of variables that are not part of the cointegrating combination.

A falsificatory framework with theory priors?

In what is probably the best worked critique of the LSE/Hendry methodology to date, Darnell and Evans (1990) suggest that a falsificatory framework with theory priors offers the best, and only, way to proceed in developing an econometric model. While conceding that 'general-to-specific' modelling "is seen by many as 'current best practice"[69], they claim that it is subject to the criticisms of data-mining and 'measurement without theory'. The use of economic theory to guide the choice of variables rather than the choice of models is denigrated as the use of economic concepts rather than economic theory. The long-run relationships uncovered by the general-to-specific modellers are viewed as not being firmly founded in economic theory as the concept of long-run equilibrium that the modelled variables represent is not developed as a theoretical construct.

The way forward is seen as one where there are "some underlying hypotheses, however loosely formulated"[70] that provide a basis for observation, modelling and evaluation. Simultaneously, there is a need to focus efforts on the development of dynamic relationships within

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[69]Darnell and Evans (1990), p. 93.

[70]Ibid. p. 93.

economic theory. For this study, it appears that such suggestions need to be incorporated to the greatest extent possible, through the specification of a dynamic economic model, which then provides a basis for pursuing econometric research. Following the spirit of general-to-specific modelling, such a broad specification derived from theory can then be tested, reduced and refined to yield a specific congruent econometric model.[71]

Beginning with the next chapter, I employ some of the principles discussed in this chapter in formulating models of pricing, demand and supply for Indian industry.

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[71]The exemplary work of Layard and Nickell (1986) , while not in the general to specific mould, seems to have several important features that counter much of the criticism levelled by Darnell and Evans. At the same time, some reduction is undertaken, and a large variety of tests are performed on the equations obtained.

IV

OUTLINE OF AN APPROACH TO MODELLING DEMAND

In this chapter, I present a method of modelling demand for Indian industry. I highlight the importance of studying the demand side and suggest a possible decomposition of aggregate demand. Finally, I analyse trends in government expenditure in the context of their potential impact on demand for industrial products.

Some stylised facts which suggest that demand may be important

There appears to be a need to identify the ex-ante determinants of demand for industrial products. By developing a picture of the state of demand for industrial products, it becomes possible to evaluate and test the claim that demand is indeed the prime mover in determining the extent of industrial expansion. Furthermore, if such a demand equation/relationship is a valid characterization of the process underlying industrial evolution, it would facilitate an analysis of the various components of demand and allow different phases in industrial evolution to be traced to the underlying trends in the different constituents.

Even if output is jointly determined by both demand and supply in the short-run, such a demand specification needs to be developed. In theory, it should be possible to distinguish between the two kinds of hypotheses, and an attempt to do so will be made. In the section that follows, some features will be highlighted in defence of a view emphasizing demand aspects.

Theoretical reasons and empirical evidence suggest that supply responses are predicated on changes in demand for industrial products. This should not be taken to imply that there is merely a passive adjustment to changes

in demand on the part of industrial capital. India is replete with examples of entrepreneurship and success based on the ability to look to the future and anticipate changes in demand conditions to allow such a claim to be made. It may be beneficial to consider a model in which demand behaves as the prime mover and supply accommodates the change in demand conditions. Such a hypothesis obviously allows for the possibility that individual firms anticipate changes in patterns of demand and behave in a non-mechanistic fashion so as to take advantage of these changes.

The oligopolistic structure of Indian industry

It has long been recognized that industry in India has been dominated by a large number of oligopolistic firms, many of which evolved in pre-independence times.[1] The active participation of many 'captains of industry' in the Freedom Movement and the role of large firms in the formulation of the Bombay Plan in 1944, which set the stage for the pervasive participation of the state in economic activity and industrial production, can be viewed as an indicator of future events. Hazari (1966) documented the nature of the links between the branches of the various "large business houses" and the unique characteristics of monopolistic behaviour in India. Despite regulatory legislation of various kinds, there is little reason to believe that the oligopolistic activity has ever lacked the power to dominate industrial activity.[2]

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[1]Ray (1982) provides an excellent discussion of the emergence of modern industry during British rule.

[2]It can well be argued that the MRTP and FERA acts of the early 1970s, and for that matter, bank nationalisation in 1966 and 1973, altered the nature of oligopolistic activity, without much curbing its extent.

Given the maintenance of protection for domestic production, first through quantitative restrictions, then increasingly through high import taxes; the operation of the licensing framework; and the privileged access of large business to inputs, credit, and foreign capital and technology, the oligopolistic structure of industry has been perpetuated. A particularly important outcome of this oligopolistic behaviour is the nature of price determination in industry. Kalecki (1954) and Hall and Hitch (1939) provided a theoretical basis for the link between mark-up pricing and oligopoly, the extent of the mark-up being related to the degree of monopoly in Kalecki's view. Chatterji (1989) and Balakrishnan (1991) provide evidence for the existence of such cost-plus pricing in the context of Indian industry for the period from 1950 to 1980.

Nature of pricing and ability to pass on cost increases

In an oligopolistic setting, industry has been able to pass on most cost increases to buyers of industrial commodities. By imposing a mark-up on cost, firms have been able to insulate their profits from the impact of cost increases - again a feature which would be expected in an economy with a substantial, if declining, level of agricultural raw material input use in industry, and large fluctuations in agricultural prices induced by the vagaries of the monsoon. There is also evidence which suggests that this mark-up varies little with the state of demand, and that prices are relatively invariant to the phase of the business-cycle.[3]

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[3]There appears to be some variance between the views of Chatterji (1989) and Balakrishnan (1991) as to the impact of the "activity" term. The links between the mark-up and the state of demand will be explored below, with particular emphasis on the 1980s.

The characteristics of this price-setting process provide further support for a model that focuses on the demand aspect. If an activity or demand variable has little effect on price setting in industry, and instead influences the output decision of the firm, it suggests that the supply of output responds to demand through adjustments in output rather than price. This then clears the way for attempting to build up a specification for the demand for industrial commodities.

The theoretical foundations for such a demand specification need to be made explicit, and the relative independence of the price-setting process from the conditions characterising demand assumes particular significance in this context. Such relative independence facilitates the modelling of the demand for industrial demand and allows a theoretical exploration of demand arising from consumption needs, in particular.[4]

The issue of investment goods is less transparent: can it be assumed that similar conditions extend to this sector too? Is it possible to think of an *a priori* determination of the level of investment that is somehow exogenous to demand conditions? Or should such investment demand be related only to long-run (anticipated or actual) changes in demand conditions?

The demand for industrial output

In developing a picture of the demand for industrial products, it is wise to adopt a somewhat eclectic viewpoint. This inquiry is somewhat different from the more common aggregate demand analyses, such as those dealing

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[4]Deaton and Muellbauer (1980) stress the importance of this aspect of the nature of price-setting and output determination in attempting to develop a demand function for consumer goods.

with consumption and investment functions. Certain key lessons that have been learnt from the study of such aggregates will, necessarily, have to be kept in mind, recognising that the demand for industrial output can be decomposed into that emanating from a desire to consume and that motivated by a desire to add to the stock of capital. I proceed by undertaking such a decomposition into consumption and investment demand, besides demarcating a role for government and the rest of the world. It should be quickly apparent that these components are not independent of each other.

This specification of demand is quite unlike that of demand systems - my concern is not just with the allocation of consumption expenditures, and matters such as cross price elasticities and substitution effects are of limited relevance.[5] Again, I make no attempt to adopt a representative agent framework, as is frequently done in the study of expenditure systems. Nor, for that matter, do I evaluate traditional concerns such as integrability of preferences which are important in the context of consumer behaviour.[6] While there are sufficiently forbidding obstacles to the adoption of a representative agent framework for consumption,

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[5]However, as we shall see below, the idea of two-stage budgeting developed in the context of demand analysis shall be explored with respect to food expenditures and the influence they have on consumption demand for industrial output.

[6]Stoker (1986) cautions against the "behavioural interpretation" of macroeconomic coefficients as microeconomic parameters, and suggests that distributional information needs to be taken into account in trying to reach such conclusions. Deaton and Muellbauer (1980), state "... that, for the consumption function, there is little point in attempting to find conditions under which aggregate behaviour will mirror the behaviour of some representative consumer." [pp.320] Apart from these analytical difficulties in making this transition, it is not clear that there is much mileage to be derived in attempting such an exercise here.

consideration of investment is likely to be even more intractable in such a paradigm.

The demand aggregates may appear somewhat peculiar and contrived as they are considered here - what is being considered is demand for industrial output, not demand originating in the industrial sector, nor just consumption or investment demand. If this specific purpose were kept in mind it would reduce the extent of surprise that the sometimes unfamiliar functional forms and relationships posited and estimated might otherwise elicit. However, the influence of previous work on consumption functions, investment schedules, and export demand specifications should be quite easily apparent.

The models I employ are those that have enjoyed considerable empirical and econometric success rather than the analytically more elegant, but difficult to implement Euler-equation models that have had only limited success in empirical terms. Which is not to suggest that Euler-equation models founded on intertemporal optimization by economic agents are not useful as much as to recognize their limitations given the current state of knowledge.[7]

The components of demand

The demand for industrial commodities can be decomposed as follows:

$$Dd = C_{Ipvt} + I_{Ipvt} + G_I + X_I$$

[7]For instance, see Sensenbrenner (1991) and accompanying note by Hendry (1991). The work of Muellbauer and Bover (1986) offers an instance of successful empirical use of Euler-equation models. The ECM used in this study is given an Euler-equation interpretation.

where C_{Ipvt} is private consumption demand; I_{Ipvt} represents private investment demand; G_I stands for government demand; X_I is export demand. The subscripts 'I' denote that the variables are considered with respect to the industrial sector.

A distinction of this kind allows analysis of the ultimate determinants of the level of demand, though these determinants cannot be related to the particular component of industry they impact, given the aggregative nature of the analysis. Yet changes in demand can be explicitly related to underlying components; these in turn will be related to various macroeconomic variables. Structural equations for the various components will be devised, estimated, and tested.

Of some help in a disaggregation of this nature is the availability of figures on industrial production disaggregated by end-use - capital goods, basic goods, intermediate goods, and consumer goods. This facilitates a matching of particular segments of demand with the relevant components of industrial production.[8]

The contribution of government

Government demand for industrial products is, if anything, even more difficult to model than that originating from the private sector, particularly considering the backdrop of the great increases in deficit financing that were witnessed in the 1980s. At a time when there was an increase in the level of public expenditure (best measured as a proportion

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[8]It is unfortunate that there has been no update of the figures on "Wages and productivity in selected industries 1970-84" produced by the CSO. The study by Lahiri, et al (1985) is based on the figures on ouput, wages, raw material use and productivity disaggregated by end-use made available in this compilation of ASI data.

of national income) as well as an expansion in the size of the budget deficit to unprecedented levels, modelling magnitudes which are largely politically influenced rather than economically determined becomes even more complicated.

Given the multitude of influences on the state,[9] a case can be made for treating government expenditure directed towards the industrial sector as exogenous.[10]

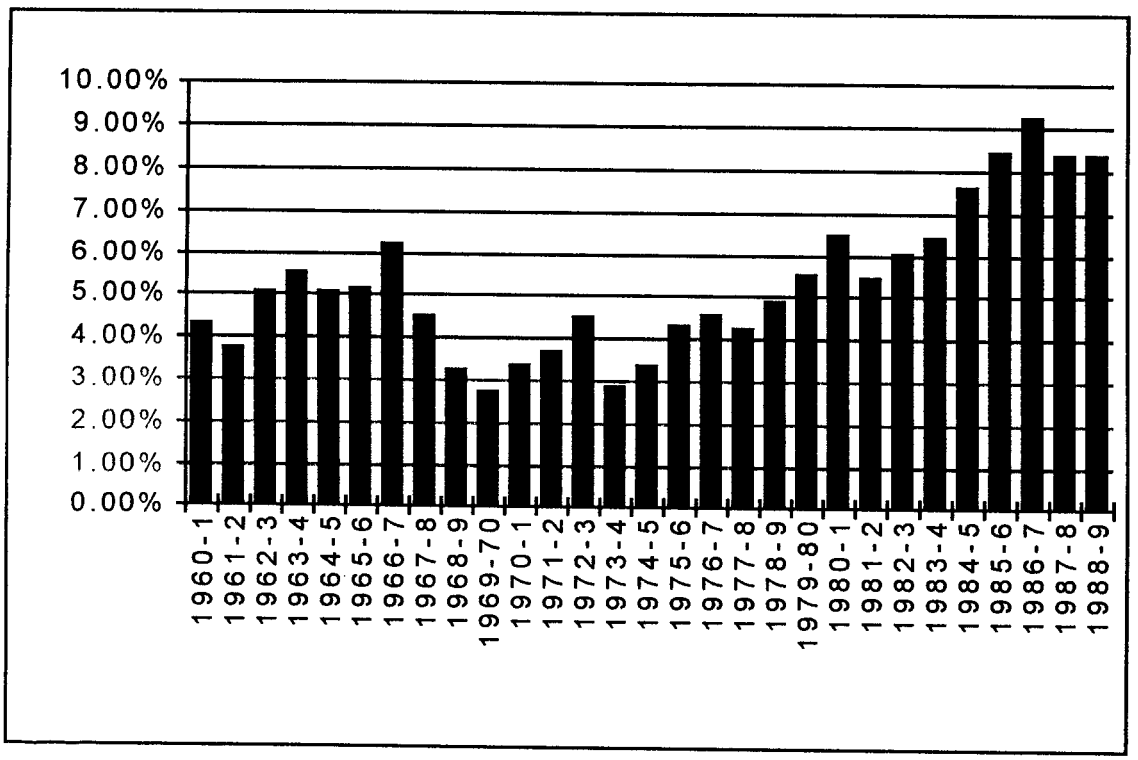

Figure IV.1: Overall Fiscal Deficit of the Centre and the States (As a proportion of GDP). Source: IMF International Financial Statistics, various issues.

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[9]The 'state' here is merely a portmanteau to cover all levels of government - central, state, and various local authorities.

[10]There is a significant quantity of recent work directed towards accounting for economic fluctuations based on changes in monetary and fiscal regimes - "political business cycles". Of course, the term can be traced as far back as Kalecki (1938?).

In considering the contribution of government demand, the backdrop of a very substantial increase in the size of the budget deficit in the 1980s must be kept in mind. The budget deficit increased from around 4% in the mid-1970s to about 6% in the early 1980s, to 8% by the end of the 1980s. These levels are viewed as 'unsustainable' by the government.[11] In addition, a major component of the structural adjustment programs proposed by multilateral lending agencies is the reduction of this figure to 5% by 1993. While the table above is based on the International Monetary Fund's figures for the gross fiscal deficit in relation to all expenditures, this trend of a large increase in the budget deficit is reflected in the movements of alternate measures such as the conventional budgetary deficit, the revenue deficit and the monetised deficit.[12]

Any expansionary impact that the increased government spending may have had on the economy could only have been heightened by the extent of deficit financing. The increased dependence on budget deficits has been viewed as largely a consequence of the inability of the government to expand the tax base and keep actual expenditure levels in line with targeted levels.[13] The combination of unproductive expenditures and

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[11]P. 3 , Economic Survey 1991-92, Part II Sectoral Developments.

[12]See Table 2.1 on p. 3 in the Economic Survey 1991-92, Part II Sectoral Developments for details.

[13]Throughout the 1980s, the actual levels of the budget deficit of the Central government exceeded the previous years estimates as presented in the Budget. Sanyal (1988) provides a view of the increase in deficits in terms of the 'fiscal crisis of the state'.

The Economic Survey 1991-92 provides a more recent analysis of the trends in public finances, and underlying causes of the increase in the fiscal deficit. See Chapter 2 on Public Finances in Part II Sectoral Developments, pp. 2-22.

transfers which are seen as the prime cause of the increase in the size of the budget deficit, even by the government, is not necessarily unproductive from the limited perspective of increasing demand. On the other hand, the fact that such increases on unproductive heads were not intended to have any stimulative impact and were largely a response to populist pressures probably kept them from being worked out to fit in an overall scheme of demand management, to the extent that there was one in the first place.[14]

The fiscal deficit can be seen as having made a distinct contribution to stimulating the economy not only by means of direct aggregate demand increases, but also through its impact on the monetary sector, an aspect that is discussed later in this dissertation. Similarly, the increase in government fiscal activity can be seen as having had an overall expansionary impact, as well as specific direct impact on the industrial sector.

As is obvious:

$$G_I \equiv GFCE_I + GGCF_{ME}$$

The most appropriate measure of G_I for the purpose of this study is a composite of public investment in machinery and equipment ($GGCF_{ME}$) and government final consumption expenditure (GFCE). Ideally, only the

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[14]There is no mention of demand management policies in any of the major policy documents of the government in the period of liberalization. On the other hand, successive Budget speeches and Economic Surveys have pointed to the trends in non-essential expenditure as requiring curtailment and control. It could be argued that there was virtually a "soft budget constraint" in operation in India, to use Kornai's now famous phrase. See Kornai (1980).

component of government consumption directed towards industry should be included in this aggregate.

This ideal measure of the magnitude of government demand for industrial output takes into account the direction of that demand, and includes only the expenditure on industrial output. Such a magnitude includes demand for consumption goods produced by industry as well as demand for capital goods produced by the industrial sector. The series for government fixed capital formation in the form of machinery and equipment provides a good indicator of the second category of demand ($GGCF_{ME}$).[15] However, measures of the first type of demand ($GFCE_I$) do not exist, nor can they be derived from the published statistics.

A breakdown of government expenditure is available, but the categorization is done according to the sector which is supposed to benefit rather than the sector which produces the commodities that are finally purchased. Total government final consumption expenditure, however, does provide some idea of all consumption demand. It appears reasonable to argue that the proportion of this expenditure directed towards the industrial sector was roughly constant in proportional terms. The justification for this view is simple - the proportion of government consumption demand directed towards the non-primary sector is likely to have increased, and even if the share of the tertiary sector increased relative to the share of the secondary sector, broad trends in the

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[15]As virtually all investment was controlled by the state through the regime of licensing and quotas, any capital formation decision, once taken and approved, was more than likely to be realised in practice, even if there frequently were delays in implementation. This issue of first claim to resources for capital formation is discussed below in the context of private sector demand for investment goods.

movement of the overall level of consumption expenditure would provide a rough idea of the trends in government demand for consumption goods produced in the industrial sector.

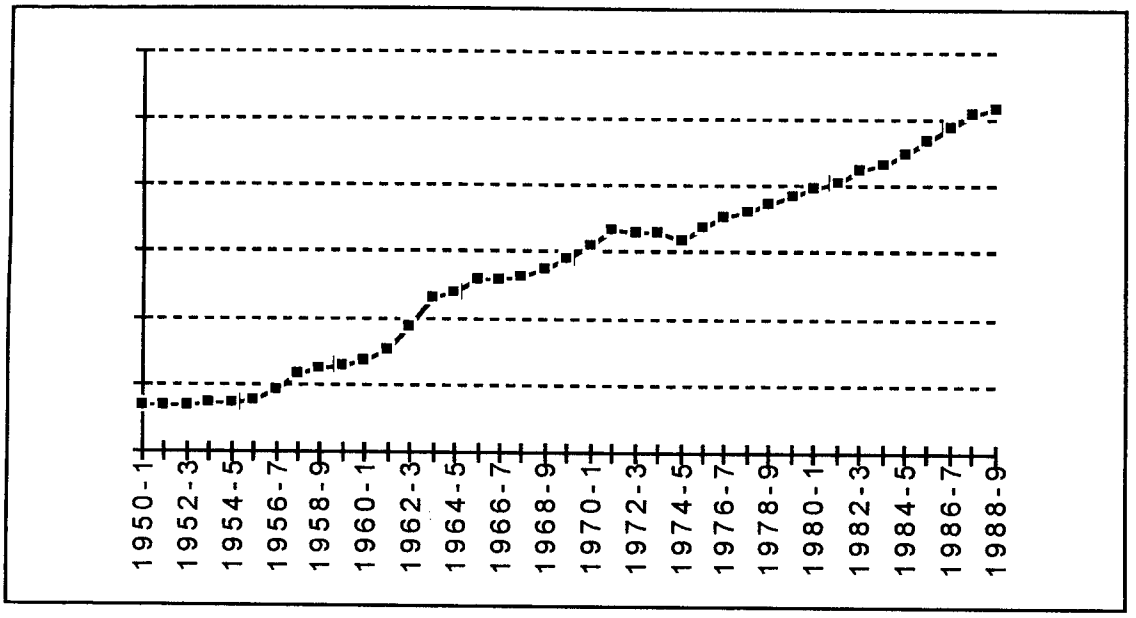

Figure IV.2: Government final consumption expenditure (1980-81 prices) [semi-log scale]. Source: National Accounts Statistics (various issues)

Government consumption expenditure expanded quite steadily from 1975 onwards, and even in 1979-80, when output contracted in real terms, there was no reduction in public consumption. The expansionary fiscal policy combined with a slower growth in revenues brought about the large increase in deficits. This fiscal crisis, combined with the foreign exchange crisis of the early 1990s finally reversed the trend of expanding public expenditure in 1991-92.

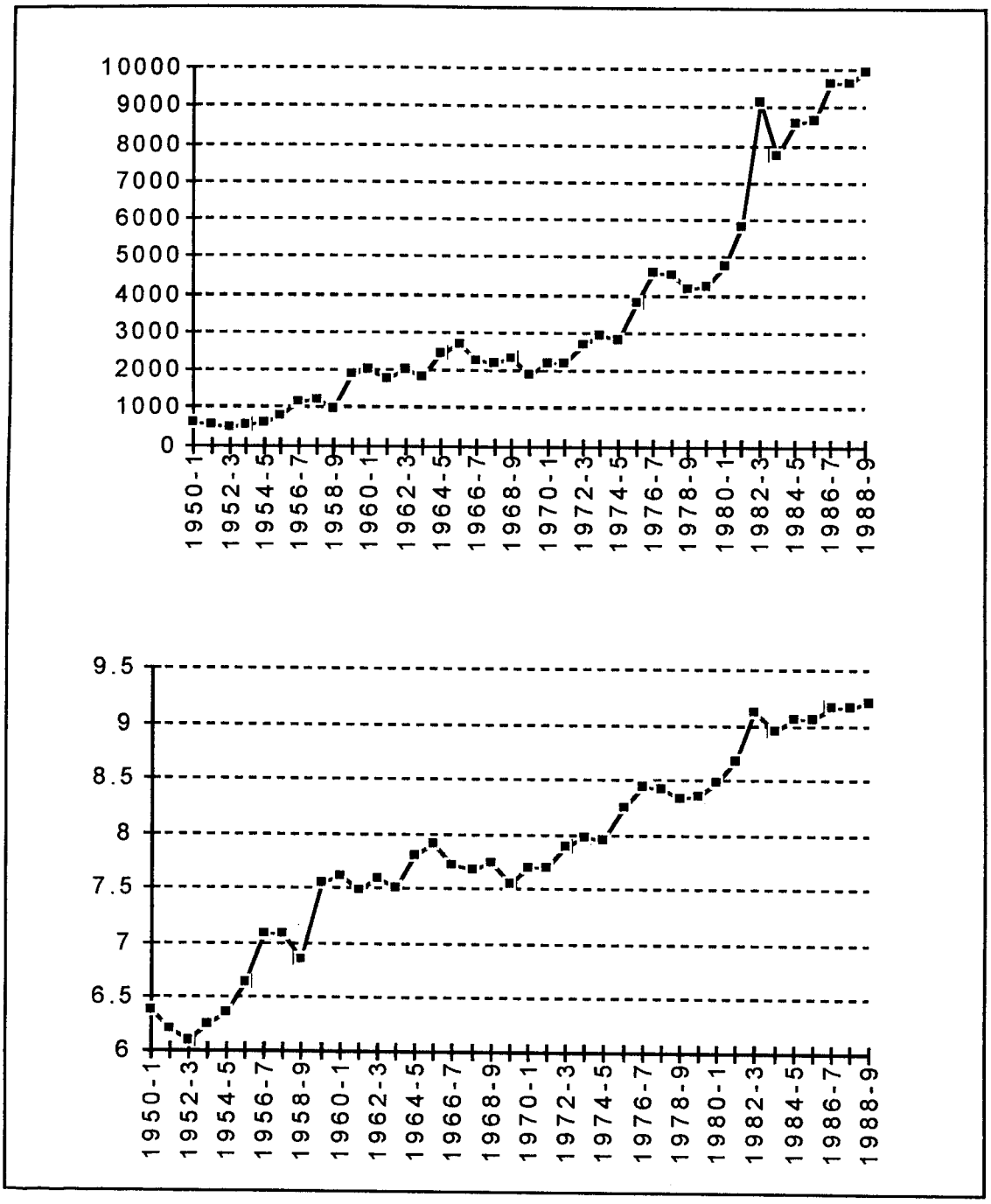

Figure IV.3: Government gross fixed capital formation in capital and machinery (1980-81 prices). Lower figure in logs. Source: National Accounts Statistics (various issues)

These graphs display quite vividly the increase in government demand for industrially made producer goods in the 1980s. The rise in equipment investment dates from 1979-80, and even on the log-scale, the increase to

1982-83 shows up quite clearly. The fall in the next year should be seen in the context of the inordinate expansion in 1982-83, and should be seen as a return to an existing trend rather than a drop from the previous year. This scenario should be contrasted with the 1960s when levels of such capital formation remained virtually constant. It is important to note that the trend rate of growth does not appear to have increased in the 1980s compared to the previous decade. This possibly reflects the increasing share of non-developmental expenditure in fiscal activity.

I will investigate the relation between public and private equipment investment in the chapter on private investment demand. The significance of the particular pattern of state expenditure that involved a sustained expansion of consumption expenditure, and a more restrained increase in equipment investment will be viewed in the context of the crowding out of private investment by public investment. For now, the backdrop of the deficit financed increase in fiscal activity should be kept in mind.

V

INDUSTRIAL PRICING

Two significant features influence price setting in Indian industry - a substantial element of oligopolistic markets and price controls. These twin themes find expression in the dependence of price on costs and the absence of a procyclical variation in the mark-up of price over cost.

Much of the work in this area is due to Chatterji (1989), and Balakrishnan (1991); I hope to establish that the main findings of these studies retain relevance for the 1980s. The principal findings of the earlier studies will be reported, and their significance for my thesis will be elaborated. I will attempt to establish that the essence of the earlier findings retain relevance in the period of liberalization in the process incorporating methodological improvements suggested by recent research to evaluate the process of pricing in Indian industry.

A valid attempt to model the demand for industry requires that the process of price determination be relatively independent of the state of demand.[1] More specifically, firms should have sufficient market power to set prices in relation to costs, retaining some flexibility over the extent of the mark-up. To establish the foundation for the scheme I have adopted to account for the dynamics of industrial development it is necessary that industrial prices be determined by factors other than demand in the short-run. I establish that labour and raw material costs are the prime determinants of industrial prices.

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[1] Deaton and Muellbauer (1980) stress the importance of this aspect in modelling demand.

Several studies of the macro-economy and the industrial sector have suggested that a mark-up rule best represents the nature of price behaviour in India. Empirical evidence for such a phenomenon has been furnished in recent years, establishing the validity of the characterisation of the industrial sector as one dominated by price setting oligopolistic firms.[2] Chatterji (1989) tests the validity of the Coutts, Godley and Nordhaus (1978) model in explaining the movements of industrial prices in the period 1947-77, and argues that prices are essentially determined by a mark-up on actual costs (rather than normal costs). In his study of "Pricing and Inflation in India", Balakrishnan (1991) provides further support for this cost-plus mechanism of industrial price setting.

The mark-up in the 1980s

To begin, I consider the behaviour of the ex-post gross mark-up or the share of profits in gross output. For aggregate industry in the period from 1947 to 1974 (for the Census sector of the Annual Survey of Industries) the mark-up was relatively stable, and varied positively with industrial growth.[3] However, this positive elasticity of the mark-up with respect to

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[2]The theoretical insight in Kalecki (1954) set the stage for several studies in that tradition. Examples of such work are Patnaik (1975), Nayyar (1978) and Mitra (1978), among others. However, such an assumption of cost-plus pricing has become more and more widespread in recent years, and with the work of Lahiri, et al (1985), Chatterji (1989), and Balakrishnan (1991), there remains little scope for scepticism about the validity of such a characterisation.

[3]Chatterji (1989) pp. 48-49, reports the following results for aggregate industry (Census Sector):

$$LMU = \underset{(0.32)}{0.29} \; \underset{(-2.11)}{-0.03\,T} \; \underset{(2.81)}{+0.79\,LIIP} \qquad R^2 = 0.58,\ D.W. = 1.82 \quad (t\text{-ratios})$$

output has been attributed to the nature of growth and the structural change that growth entailed in that period - industry groups with higher growth returned higher average mark-up rates.

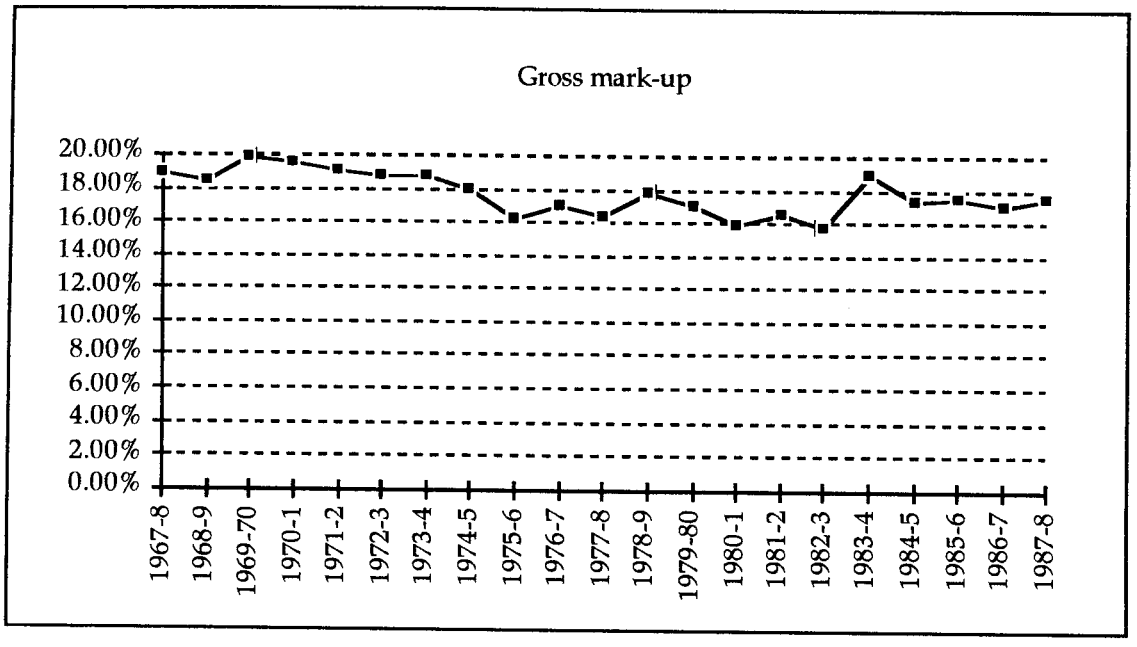

Figure V.i: The behaviour of the mark-up. Source: ASI Summary Results for the Factory Sector (various issues)]

Investigation of the period 1967-8 to 1987-8, for the Factory Sector of the Annual Survey of Industries reveals that there was very limited variation in the mark-up across this period of great variation in growth performance.[4] Estimating an equation of the form

$$mu_t = \eta_1 + \eta_2 t + \eta_3 i_t + \varepsilon_t \qquad (V.1)$$

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where LMU is the log of the crude gross mark-up rate, and LIIP is the log of the Index of Industrial Production, the preferred measure of output.

[4]Data was collected for the Census sector only up to 1982-83, necessitating the use of Factory Sector data. Though the time-span of this data-series is shorter, it covers the vital

to test for the existence of a secular movement in the mark-up rate and any relation to industrial output (i_t) yielded the following results:

Table V.1: Variation of the gross mark-up (1967-68 to 1987-88) OLS estimates.

	Coefficient	t-value
η_1	-11.45	-4.12
η_2	-0.0544	-3.98
η_3	1.004	3.52

Adjusted R^2 = 0.56 ; σ= 4.57%; DW=1.628.

These results are very similar to those obtained by Chatterji (1989). They reveal the existence of a secular decline in the extent of the mark-up rate, and a positive relation to the level of industrial output.[5]

The equation does not add very much to the picture that the graph of the mark-up depicts. The results are also weakened by the interdependence of t and i_t, since the level, an I(1) variable, rather than the rate of growth of industrial output, an I(0) variable, is used. While the explanation advanced by Chatterji, in which a secular decline in the mark-up is balanced by an increase in the share of industries (or firms) with relatively higher mark-ups, seems intuitively appealing, the econometric basis of

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period of the 1980s, and is perhaps a more representative, and certainly a wider, sample of industry.

[5]The measure of industrial output adopted here is real GDP at factor cost originating in the industrial sector (1980-1 prices). The new IIP (1980-1=100) was also used as a measure of

such a statement is suspect. The relative constancy of the mark-up rate across the periods of constrasting performance is, however, significant.

Pricing behaviour largely dependent on the dynamics of cost and independent of "activity"

The relative stability of the mark-up sets the stage for a discussion of the price-setting process in industry. That price is closely related to cost and relatively unaffected by the state of industrial activity has been fairly well established for the period up to the beginning of the 1980s.[6] I look only at the period up to 1982-3 in the context of the earlier findings for the Census Sector of the Annual Survey of Industries (ASI), limited by the discontinuation of this series, and for the span from 1967-8 to 1987-8 for the Factory Sector. Despite a halved data span, the enhanced coverage in terms of industrial units, and the more recent coverage in terms of time, justify an investigation using the series for the Factory Sector.

Balakrishnan (1991) incorporates recent developments in econometric modelling in terms of cointegration and ECMs, but the results reflect substantially the same processes as those identified in Chatterji (1989). Balakrishnan also identifies a negative coefficient on the lagged activity term in the price equation for industry. Balakrishnan reports a variety of results that show that industrial prices for the period 1950-1 to 1979-80 were largely dependent on raw material and labour costs, and varied

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output, but the results obtained with GDP were more robust - encompassing tests revealed unequivocally the superiority of the equation using GDP to derive i_t.

counter-cyclically, or were negatively related to the level of "activity".[7] This negative relation, however, is not determined in a robust fashion, suggesting that such a relation is somewhat tenuous and perhaps reflects the limited dependence of price changes to the level of activity in industry.

I test the equation ultimately preferred by Balakrishnan for its forecast performance in the first years of the 1980s, investigating whether the estimated parameters are stable outside sample for the years for which figures are available. I then suggest an alternative specification for the price equation, which appears to yield better results for the same set of Census Sector data and subsequently estimate a similar price equation for the Factory Sector data for 1967-8 to 1987-8.

Balakrishnan uses a variety of different functional forms for a price equation for aggregate industry, the best specified of which is:

$$\Delta p_t = \alpha_0 + \alpha_1 \Delta w_t + \alpha_2 \Delta m_t + \alpha_3 (pi\text{-}m)_{t-1} + \alpha_4 (w\text{-}m)_{t-1} + \alpha_5 d_{t-1} + \varepsilon_t \quad [8] \quad (V.2)$$

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[6]Chatterji (1989) covers the period 1947-74, and Balakrishnan (1991) the period from 1950-80.

[7]The word "activity" is used rather than demand, on account of the conceptual and operational difficulties in measuring this variable. The measure used here for activity is the ratio to five-year moving average, which Chatterji (1989) calls the "Potential Utilisation Ratio" (PUR). Balakrishnan (1991) uses a Wharton index of capacity utilisation in addition to such a PUR.

[8]Balakrishnan (1991) pp. 137-8. On pp. 133-4, he explains that $\alpha_3 < 0$ and $\alpha_4 > 0$ implies the existence of a significant ECM. In addition, such a specification gets around the problems that multi-collinearity may potentially pose.

Table V.2: EC Price equation for aggregate industry - Balakrishnan (1991) p. 138.

Variable	α_0	α_1	α_2	α_3	α_4	α_5
Coefficient	2.55	0.57	0.43	-0.34	0.21	-0.56
t-value	2.64	2.45	4.75	4.75	2.01	2.64

D.W. = 1.67; R^2 = 0.78; σ = 4%. (OLS estimates for annual data 1952-3 to 1979-80.)

The w, m and p_i series are shown to be I(1), which "establish the pre-requisites for inferring co-integration between prices and costs in Indian manufacturing industry from the discovery of an error-correcting mechanism relating prices to costs."[9] However, the performance of this ECM representation of the price equation is surpassed by an equation in which no such restrictions are imposed on the parameters. An unrestricted equation, which has a different parsimonious functional form than the EC price equation above, has a superior performance for the period in question, in addition to more adequately capturing the extended period to 1982-3.

I estimated an equation identical to that above, with the only difference being that I used a measure of activity based on the Index of Industrial Production (ratio to five-year moving average) rather than the Wharton

[9]Balakrishnan (1991) pp. 144. This follows from the Engle and Granger (1987) result that all cointegrated series have an ECM representation and vice-versa. Of course, an ECM is only one of several interpretations that can be attached to cointegrated series, as Hylleberg and Mizon (1990) show.

index of capacity utilisation used by Balakrishnan (1991). Hence, I use a_t rather than d_t to indicate activity. The results obtained are as follows:

Table V.3: Price Equation for Aggregate Industry - ECM

	α_0	α_1	α_2	α_3	α_4	α_5
Coefficient	-0.65	0.28	0.44	-0.13	0.04	0.14
t-value	-0.32	1.15	4.02	-0.92	0.40	0.32

D.W. = 1.60; Adjusted R^2 = 0.74; σ = 4.66%. (OLS estimates for annual data 1952-3 to 1982-3 less 3 forecasts.)

Chow F (3, 22) = 0.45; Normality χ^2 = 5.98; AR 1-3 F (3, 19) = 0.62; ARCH 3 F (3, 16) = 0.38; Heteroscedastic errors F (10, 11) = 0.93; Forecast χ^2 (3)/3 = 0.79.

In comparison, an unrestricted equation for the same period with a similar forecast period yielded the following parsimonious form:

$$\Delta p_t = \alpha_0 + \alpha_1 \Delta w_t + \alpha_2 \Delta m_t + \alpha_3 p_{t-1} + \alpha_4 m_{t-1} + \alpha_5 \Delta a_{t-1} + \alpha_6 t + \varepsilon_t \quad (V.3)$$

Table V.4: Price Equation for Aggregate Industry - Unrestricted

	α_0	α_1	α_2	α_3	α_4	α_5	α_6
Coefficient	0.86	0.27	0.42	-0.54	0.32	-0.38	0.01
t-value	2.97	1.84	5.10	-3.15	2.87	-1.69	2.28

D.W. = 1.93; Adjusted R^2 = 0.86; σ = 2.98%. (OLS estimates for annual data 1952-3 to 1982-3 less 3 forecasts.)

Chow F (3, 20) = 0.17; Normality χ^2 = 0.34; AR 1-3 F (3, 17) = 3.56; ARCH 3 F (3, 14) = 0.03; Forecast χ^2 (3)/3 = 0.40.

The unrestricted equation outperforms the ECM representation on several criteria - lower standard error, higher R^2, and better forecast performance.[10] As both forms appear to be well specified,[11] such a comparison is both legitimate, and, given the impossibility of conducting encompassing tests, necessary to separate the winner from the contender. What is important is that both forms reiterate the importance of cost elements in price determination, with a role for activity that tends to be ambiguous in magnitude as well as direction, reinforcing the conclusions of Chatterji (1989) and Balakrishnan (1991).

Extension of this investigation to the 1980s for aggregate industry

The availability of figures for all registered manufacturing units (the Factory Sector of the Annual Survey of Industries) for most of the 1980s lends itself to a similar exercise to investigate the importance of cost elements in price setting in industry.

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[10]A comparison of the 1-step forecast performance:

Table : Forecast t-values

Date	ECM	Unrestricted
1980-1	-0.21	-0.38
1981-2	-0.46	-0.39
1982-3	-1.13	-0.61

[11]Though the value of the autoregression F test for the unrestricted equation does appear to be high.

Table V.5: Integration statistics

Variable	D.W.	D.F.	A.D.F.
p	0.0485	-2.126	-4.114*
w	0.0486	-1.333	-1.824
m	0.0694	-1.603	-2.236
a	1.22	-3.794*	-5.733**

1969-70 to 1987-88, 19 observations. D.W. = Durbin-Watson test statistic, D.F. = Dickey-Fuller test statistic, A.D.F. = Augmented Dickey Fuller test statistic. For variables that incorporated a time trend, the test statistics were evaluated including a trend. Evaluated using PC-GIVE 7.0. * indicates significance at the 5% level, and ** at the 1% level.[12]

The tests for the existence of a unit root indicate that the activity index is I(0), and the cost variables are integrated of order one. The price term has a significant ADF statistic, but the DF and DW values indicate that the hypothesis of a unit root should be accepted.[13] The graphs of the variables confirm these results.[14] In the equations below, the activity index is used in level form to determine its effect on pricing.

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[12]See Doornik and Hendry (1992) for a description of the tests for a unit root.

[13]The significant ADF test statistic for p could have arisen due to the small size of the sample.

[14]See Appendix for graphs of the model variables.

A first-order autoregression for p_t involving labour cost and raw material input prices supplied the static long run equation:

$$p_t = -0.662 + 1.345\, w_t - 0.205\, m_t \qquad \text{(V.4)}$$
$$\quad (0.743) \quad (0.586) \quad (0.440) \quad \text{(standard error)}$$

OLS estimates - 1968-9 to 1987-8. (Wald test χ^2 (3) = 10912.3)

This equation suggests that prices and costs may be related in the long run. The coefficient on the raw material price term seems very low in relation to the standard error, suggesting that it is not significantly different from zero. The elasticity of price to labour cost is greater than one, and this may be due to the effect of the poorly determined coefficient for raw material cost. An autoregressive distributed lag for Δp involving Δw, Δm, a, and lagged values of p, w, and m yielded, after reduction, the final specification:

$$\Delta p_t = \alpha_0 + \alpha_1 \Delta m_t + \alpha_2 p_{t-1} + \alpha_3 w_{t-1} + \alpha_4 a_t + \varepsilon_t \quad [15] \qquad \text{(V.5)}$$

Table V.6: Price Equation for Aggregate Industry - Unrestricted

Variable	α_0	α_1	α_2	α_3	α_4
Coefficient	-0.04	0.37	-0.31	0.32	-0.68
t-value	-0.62	6.86	-2.36	2.40	-5.04

D.W. = 2.15; Adjusted R^2 = 0.90; σ = 2.65%. (RLS estimates for annual data 1968-9 to 1987-8.)

[15]The activity term here is derived using Real GDP originating in the registered manufacturing sector, which is essentially the same as the Factory Sector of the ASI. Other variables are the same as for the Census Sector equations above.

Normality $\chi^2 = 0.34$; AR 1-2 F (2, 13) = 0.07; ARCH 1 F (1, 13) = 0.82.

The coefficient values suggest that the price and labour cost series may be cointegrated, and the equation is re-estimated after imposing the restriction $(\alpha_2 + \alpha_3) = 0$. This yields the equation:

$$\Delta p_t = \alpha_0 + \alpha_1 \Delta m_t + \alpha_5 (p_{t-1} - w_{t-1}) + \alpha_4 a_t + \varepsilon_t \qquad (V.6)$$

Table V.7: Price Equation for Aggregate Industry - ECM

Variable	α_0	α_1	α_5	α_4
Coefficient	0.01	0.36	-0.46	-0.71
t-value	0.76	6.09	-2.58	-4.90

D.W. = 2.03; Adjusted $R^2 = 0.90$; $\sigma = 2.72\%$. (RLS estimates for annual data 1968-9 to 1987-8 less 3 forecasts.)

Chow F (3, 13) = 0.78; Normality $\chi^2 = 0.65$; AR 1-2 F (2, 11) = 0.14; ARCH 2 F (2, 9) = 1.24; Forecast χ^2 (3)/3 = 1.53.

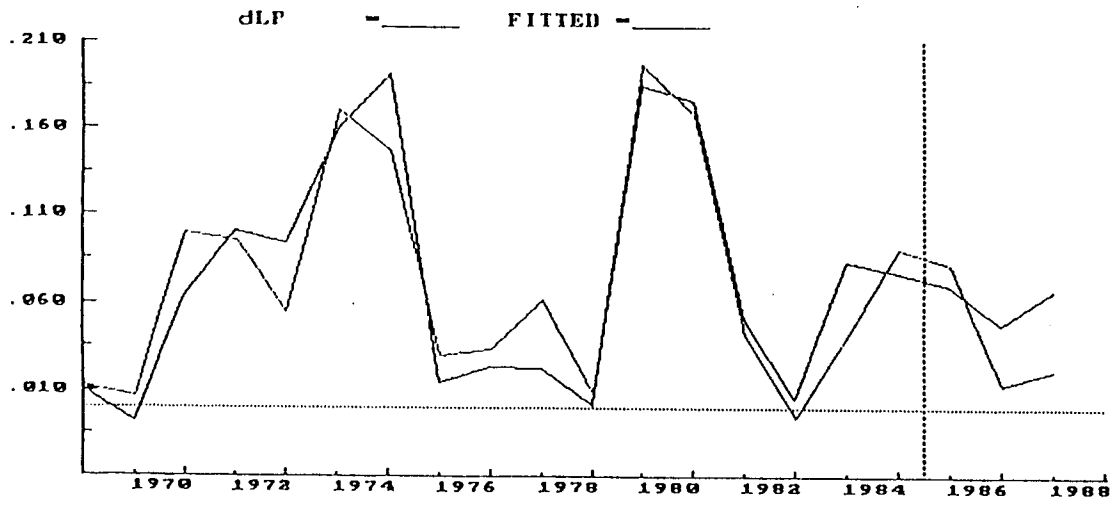

Figure V.ii: Actual and fitted values for Δp_t.

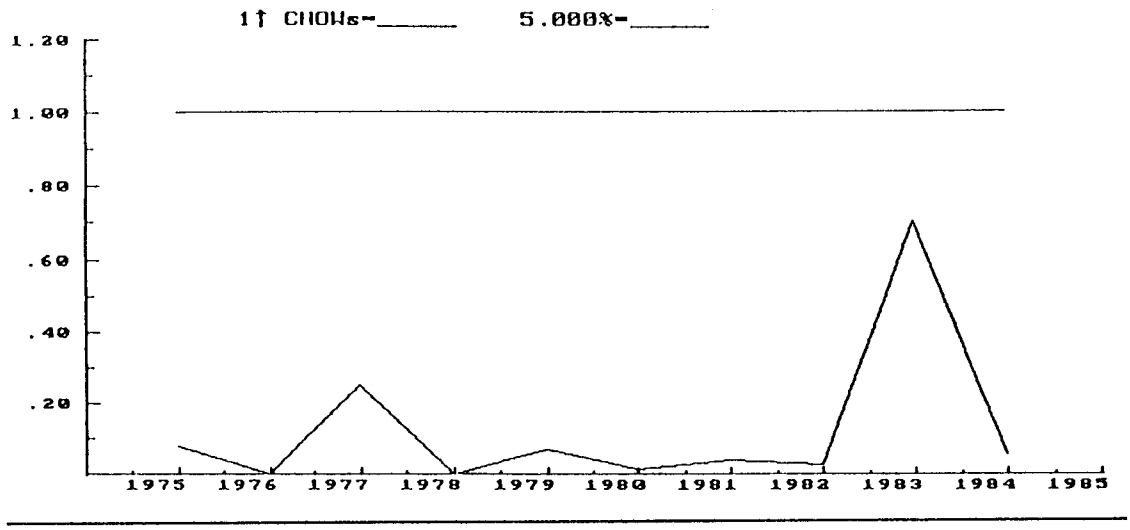

Figure V.iii: Sequence of one-step Chow tests

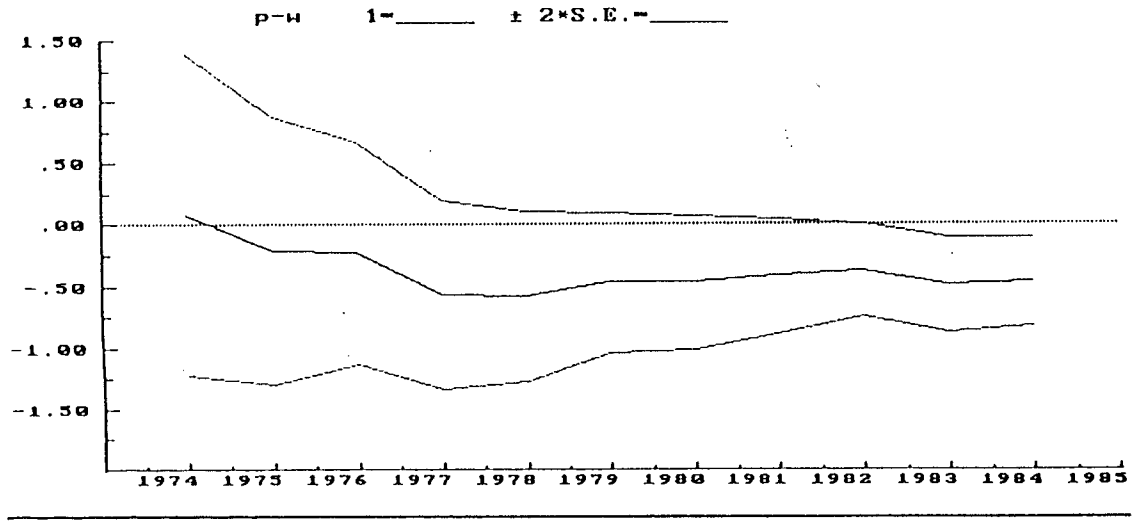

Figure V.iv: Sequence of coefficient values on the EC term.

This equation was estimated recursively to check for structural breaks and to establish the constancy of the parameters. The 1-step ahead, many step ahead Chow tests, and other graphical checks on the estimated coefficients discounted non-constancy of the parameter estimates. This provides support to the contention that costs continued to play a critical role in the determination of prices in the 1980s. Furthermore, the negative value of the coefficient on the activity term suggests that prices did not move pro-cyclically with production.

A cointegration approach: the Johansen Maximum Likelihood Estimator and further testing

As a further check on the estimated price equation, the Johansen Maximum Likelihood method was applied to identify possible cointegration vectors involving industrial prices and costs. The eigenvalues (μ_j) obtained for the MLE procedure involving prices, wages and raw material costs are:

j	μ_j	$-T \log(1-\mu_j)$	$T\Sigma \log(1-\mu_j)$
1	0.0322	0.654	0.654
2	0.2367	5.401	6.055
3	0.5241	14.851	20.906

(1969-70 to 1987-88)

The matrix of (standardized) cointegrating weights β' is:

Variable	p_t	w_t	m_t
p_t	1.00	-3.42	1.79
w_t	-2.08	1.00	0.96
m_t	-9.04	6.52	1.00

The corresponding response (feedback) coefficients (the α matrix) are:

Variable	p_t	w_t	m_t
p_t	-0.096	0.093	0.013
w_t	0.139	0.016	0.012
m_t	-0.157	-0.195	0.023

The values of the cointegration rank test statistics are inconclusive regarding the existence of cointegrating vector(s). The very small size of the sample could be one important cause of the absence of a clear answer to the question which the Johansen procedure poses. The procedure was used to investigate the possibility of cointegration between p and w, and the results obtained involving those two variables alone seem clearer and more easily interpretable.

The eigenvalues, and the cointegration rank test statistics obtained are:

j	μ_j	$-T \log(1-\mu_j)$	$T\Sigma \log(1-\mu_j)$
1	0.0847	1.681	1.681
2	0.3369	7.806	9.488

(1969-70 to 1987-8)

The standardized eigenvectors are:

Variable	p_t	w_t
p_t	1.00	-1.04
w_t	-1.42	1.00

and the matrix of adjustment coefficients is:

Variable	p_t	w_t
p_t	-0.66	0.06
w_t	0.19	0.09

The Johansen Maximum Likelihood test statistics support the existence of a cointegrating relation between p_t and w_t, involving a unit coefficient on labour cost, and the sign of the feedback coefficient supports an error-correction interpretation. The size of the coefficient on the EC term is similar to that obtained in Eqn. V.7. Accordingly, the price equation employing the labour cost variable in the EC term only, and using the raw material input cost term in impact form can be justified in terms of the Johansen method as well.

Investigating the industrial price-setting process using the MLE method confirms the importance of costs in determining the value of industrial prices and confirms that prices move in an opposite direction to the level of industrial activity. From the point of view of this thesis, these relationships allow me to estimate demand relationships that are independent of the price-setting process.

Cost terms have a significant influence on industrial prices, in impact form and/or long run form. The particular form of the price-equation that performs best is not quite as important as the message emerging from every single estimate: costs determine prices in industry, and, to the extent that activity, or demand, plays a role, it is countercyclical and equilibrating.

Disaggregated analysis

The hypothesis of the absence of a positive relationship between activity and price, given costs, for the organised manufacturing sector is supported by evidence at the level of disaggregated industry groups, in Chatterji (1989). She finds no evidence for individual industries of any positive influence of activity on the mark-up. In two of the six industry groups considered in her study, a negative relationship is detected between activity and the mark-up.[16]

The changes in the classification of the ASI makes the estimation of a price-cost-activity relation at a disaggregated level difficult. However, to provide support to the contention that industrial prices did not increase in response to demand pressures in the 1980s either, I provide a graphical analysis for seven industries. The short span of the statistics available, and the non-availability of cost figures necessitated the use of graphical rather than formal econometric methods.

The level of production in any period is the result of an interaction between supply and demand aspects. Capacity use may be constrained by supply bottlenecks as well as deficient demand. However, if demand is

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[16]Chatterji (1989) states on pp. 157-8 that, "the fundamental conclusion of this study is that prices are based on a mark-up over costs and that demand factors have no significant role to play".

expanding, only supply constraints could limit the expansion of output. Such supply constraints could arise from limited capacity or the non-availability of variable inputs such as raw materials. If the supply of raw materials is a constraint, additions to capacity are not likely to enable an expansion of production. Therefore, increases in production that do not lead to an elimination of excess capacity in the long-term suggest that raw material or variable input supply is not the binding constraint on firms that want to increase output. In view of the persistence of excess capacity, then, demand pressures can be viewed as those necessitating a rise in capacity use. Increases in capacity utilisation that are not accompanied by increases in (relative) price can possibly be taken to indicate that demand pressure has little impact on price.

Two qualifications are useful at this point. First, the identification of demand for a specific industry is extremely difficult. At the level of disaggregation considered below, there is always the possibility that demand for a specific commodity exhibits characteristics substantially different from those for demand for all industry. Second, the process of temporal aggregation that yields the annual figures for installed capacity and production conceals the short-term fluctuations in capacity utilisation that may have given a better clue to the underlying cause of excess capacity.

The selected industries are all characterised by increasing levels of output, though the patterns of long-term movement in the relative price are varied. The juxtaposition of the trends in price, production, and capacity use is designed to highlight the possible role of excess capacity in insulating price movements from the impact of demand increases.

In the graphs below, product 'price' refers to the wholesale price for the product relative to the wholesale price index for all industry. The relevant wholesale price index is scaled by the overall index of industrial prices as appropriate cost figures are not available. Movements in this relative price help to isolate and reflect the impact of change in a particular industry. The figures for levels of capacity utilisation are derived from the statistics on installed capacity and production published by the Central Statistical Organisation. These figures pertain to numbers of physical units of output, and are therefore free of errors that may have resulted from calculations involving values and prices. The relevant wholesale price index is scaled by the overall index of industrial prices as appropriate cost figures are not available. Movements in this relative price help to isolate and reflect the impact of change in a particular industry.

Source (for all the industries considered below): CSO (*Production and Installed Capacity in Selected Industries*) and TPG

Prices and capacity utilisation are measured along the left vertical axis. Production is measured in physical units, along the right vertical axis.

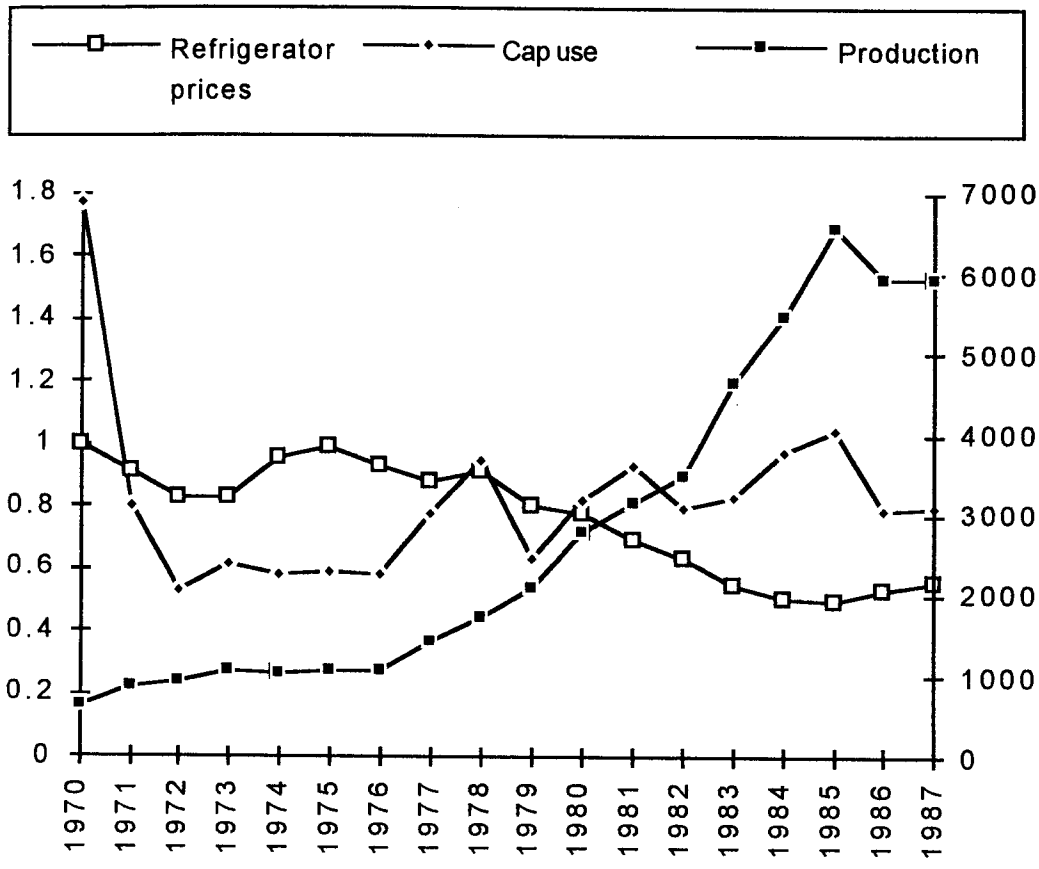

Figure V. v: Production, prices and capacity use in the refrigerator industry

Refrigerators: This consumer durable industry displays increasing production and price falling in the long-run. There appears to be an increase in the average level of capacity utilisation from the 1970s to the 1980s accompanying the decline in relative price. The increases in capacity use in the 1980s do not appear to have been accompanied by short-run increases in price.

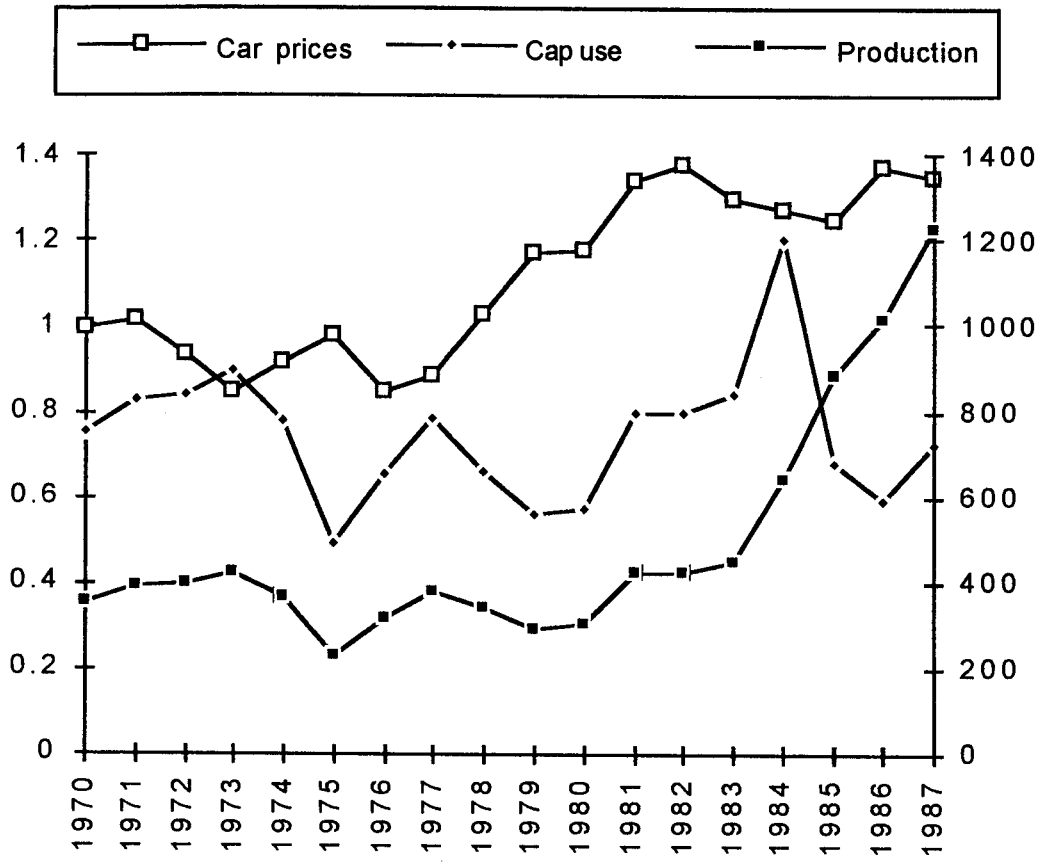

Figure V. vi: Production, prices and capacity use in the motor car industry

Motor cars: Until 1985 when Maruti Udyog commenced production, capacity utilisation levels reflected changes in production only. Price increases were accompanied by declines in production as well as increases in capacity use. There does not appear to be any systematic relation between prices and demand.

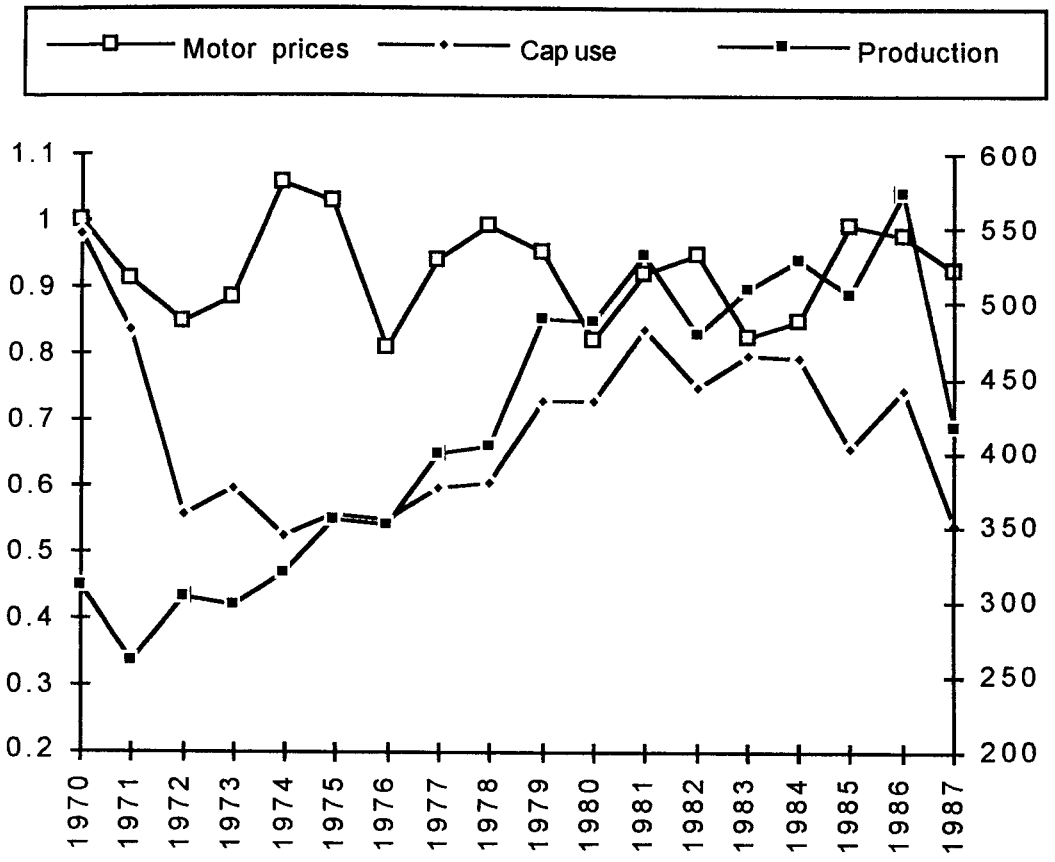

Figure V. vii: Production, prices and capacity use in the electric motor industry

Electric motors: In the case of this producer good, production levels grew slowly, and excess capacity was maintained by the creation of productive capacity. An increase in price coincides just once with an increase in capacity utilisation in the 1980s, and the two appear to move in opposite directions for most of the period considered. No systematic relationship appears to exist between production and prices.

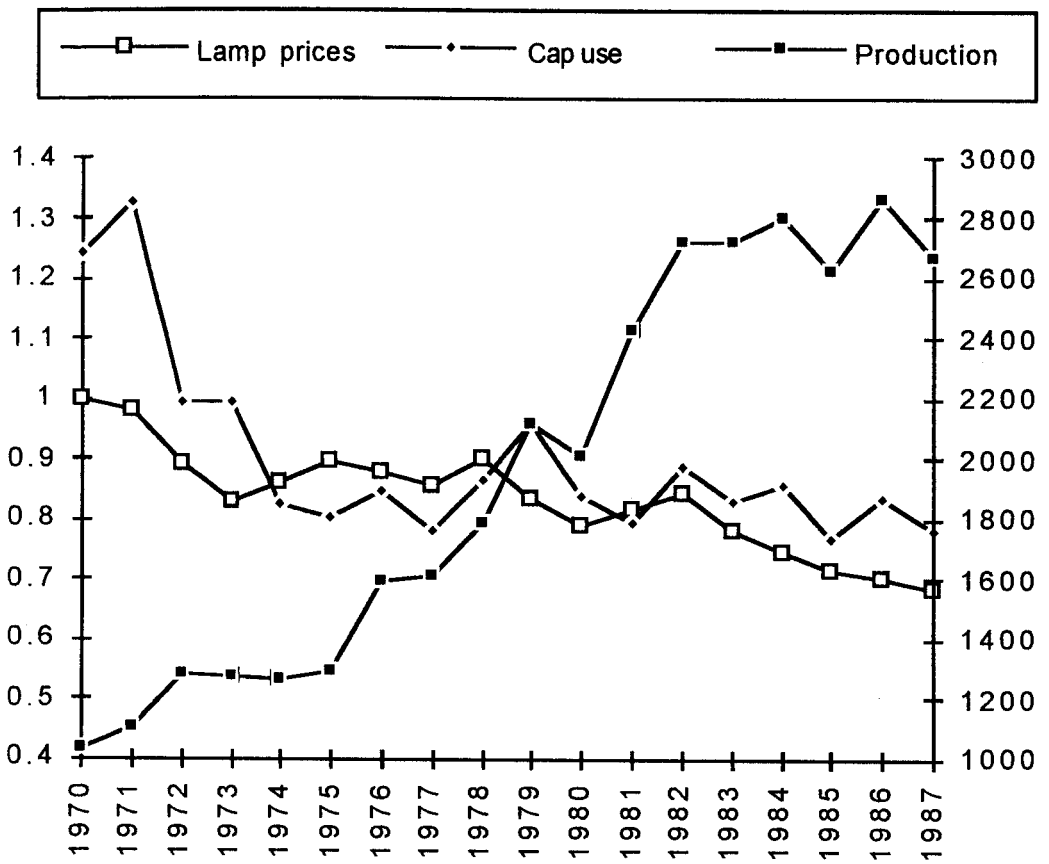

Figure V. viii: Production, prices and capacity use in the electric lamp industry

Electric lamps: The increasing output was accompanied by a secular fall in price. While prices increase along with capacity use in some years, it would be difficult to sustain the claim that increases in demand that brought about increase in the level of activity also resulted in price increases.

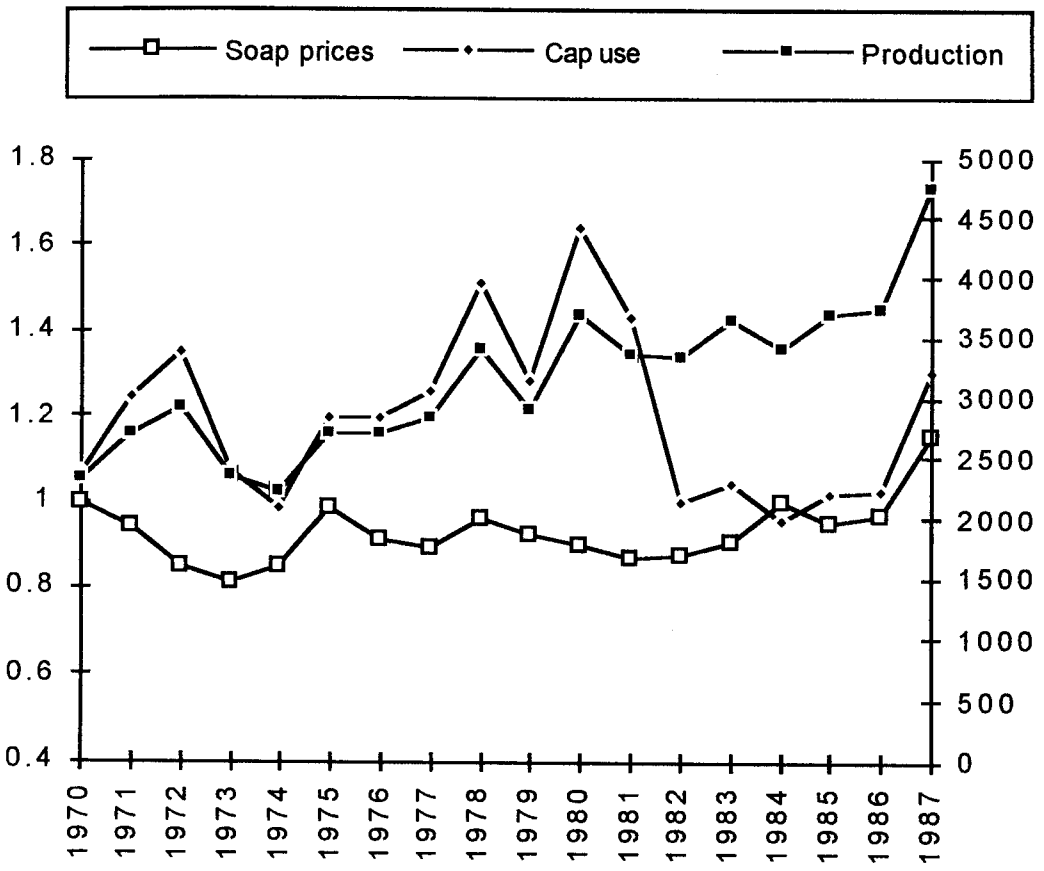

Figure V. ix: Production, prices and capacity use in the soap industry

Soap: Production levels greater than installed capacity characterise the soap industry. Increases in capacity use, even in the absence of slack, do not appear to have usually been accompanied by procyclical movements in soap prices. The large increase in production in 1980 brought about by increasing capacity use from 130% to 160% was not accompanied by an increase in price.

The greater than hundred per cent capacity use levels observed in the soap industry underscore the point that productive potential may well be greater than installed capacity for an industry.

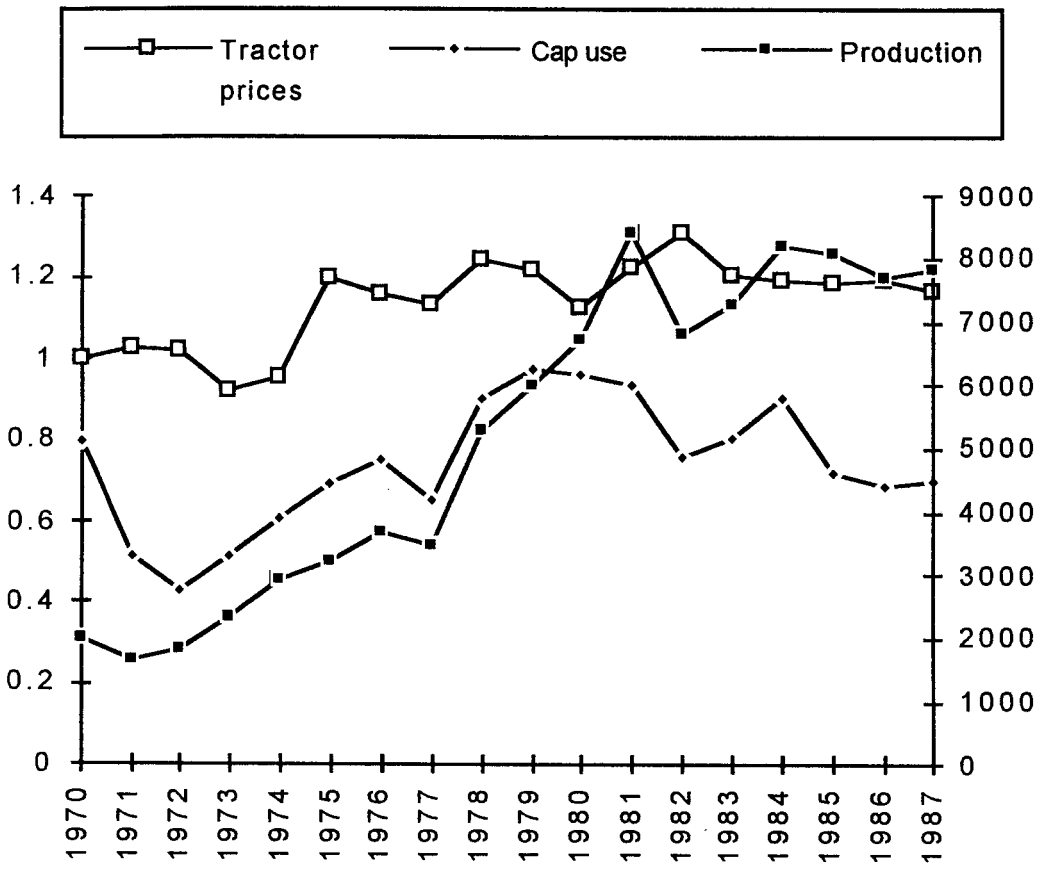

Figure V. x: Production, prices and capacity use in the tractor industry

Tractors: Stable capacity levels in the 1970s meant that increases in production induced a reduction in slack. By the mid-1980s, more capacity had been created to cause the re-emergence of such slack. Again, there is no systematic relationship apparent between prices and production, or capacity use.

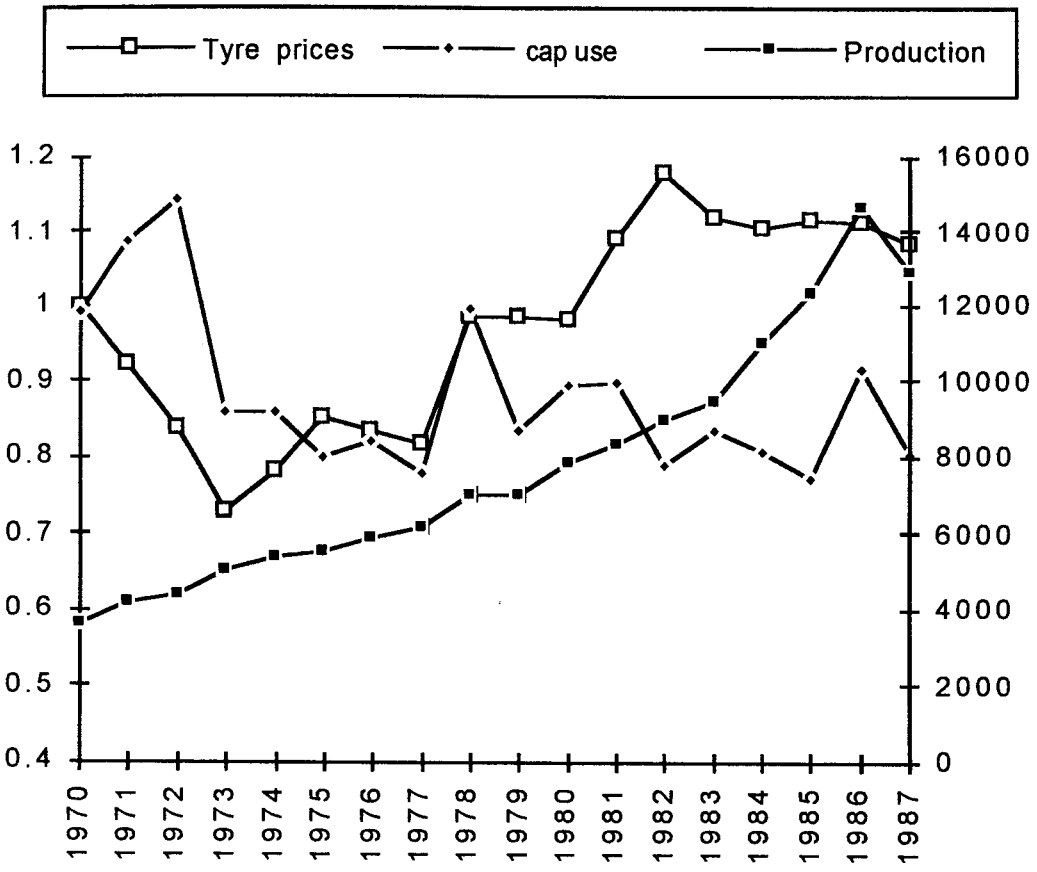

Figure V. xi: Production, prices and capacity use in the automobile tyre industry

Automobile tyres: Increasing production was accompanied by prices that increased in the long-run but capacity use levels were maintained at around 80%. Only once does an increase in capacity use coincide with an increase in price.

It is particularly noteworthy that, in all but one of the varied set of commodities examined, substantial levels of unutilised productive capacity continued to be maintained even though demand, and output,

expanded substantially over the eighteen year period considered.[17] Additional support for this phenomenon of the persistence of excess capacity can be obtained from the statistics on aggregate levels of capacity use.[18]

The disaggregated analysis does not provide any evidence that suggests that the conclusions reached in the context of aggregate industry are a result only of the process of agglomeration. The demonstration of the absence of pressure on prices in response to demand clears the way for modelling demand. The private demand for industrial output for consumption and investment is the subject of the next two chapters.

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[17]The exception is the soap industry, where production levels were consistently greater than levels of installed capacity.

[18]Statistics on capacity utilisation are reproduced in the Appendix. The subject of excess capacity is also discussed in Chapters IX and X.

VI

CONSUMPTION DEMAND

The central importance of consumer demand to industrial expansion is self-evident. In the context of the period of liberalization and faster industrial expansion, it assumes even greater significance due to the increase in the production and consumption of more visible, conspicuous luxury consumer durables in the early 1980s.[1]

This chapter attempts to model the demand for industrial output arising from the motive of consumption. I develop a consumption function to model private consumption demand for industrial products. A consumption function also helps to address issues pertaining to saving, the counterpart of consumption. I follow a two-stage budgeting approach that is analogous to 2-stage budgeting in the context of individual consumption.[2] A consumption function is developed as the first step, and this is combined with a second step that examines the allocation of consumption expenditures to industrial products.[3] In addition to such a

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[1]Patnaik (1987) and Chandrashekhar (1987) suggest that a major cause of the acceleration in industrial production was the release of pent-up demand for luxury consumer durables such as cars, scooters and motorcycles, televisions and videos, which they saw as a once-for all demand impulse that was unlikely to be sustained.

[2]Blundell (1988) in his survey of consumer behaviour provides underpinnings of such 2-stage budgeting processes. However, the budgeting is first undertaken with respect to broad commodity groups and then expenditures are allocated within group.

[3]This 2-stage consumption budgeting approach should be distinguished from the Engle and Granger (1987) 2-step estimation procedure used to identify cointegrating vectors and identify ECMs.

recursive system, I develop a 'direct' model for consumption demand for manufactures. This 'direct' model corresponds to a situation in which the overall level of consumption and the amount of industrial products consumed are chosen simultaneously. Ultimately, the choice between the two methods can be made on econometric grounds.

A consumption function approach with 2-stage budgeting

The two-stage consumption function involves two steps:

i. Estimation of a consumption function:

$$C = c (Y_d, P, r) \qquad \text{(VI.1)}$$

(C is consumption, Y_d is disposable income, P indicates price, and r the interest rate.)

Needless to say, dynamics need to be properly specified, and the possibility of cointegration investigated. If the existence of a cointegrating vector is established, a corresponding error correction mechanism can be developed.[4] This kind of a consumption function should prove useful and instructive in various macroeconomic contexts besides that of demand for industrial products.

ii. Allocation of consumption expenditures between commodity groups. Given the special importance of food expenditures in the Indian context and the extent of consumption that is not significantly greater than

[4]The Granger representation theorem establishes such a correspondence between sets of cointegrating vectors and error-correcting models. See Engle and Granger (1987).

subsistence levels, there is some justification for a view that looks at all non-food consumption as following a food consumption decision.[5]

If a first claim is exercised by food consumption this process can be represented as:

$$\text{I: } C_f = c_f (C, P_f) \qquad \text{(VI.2)}$$

$$\text{II: } C_I = c_I (C - C_f, P_I/P_{rest}) \qquad \text{(VI.3)}$$

(The subscript f refers to food, I to industrial products and rest to all other consumables.)

In the absence of a prior claim on expenditures by food, consumption demand for all three categories of products is determined simultaneously. In such a case:

$$C_I = c_{\tilde{I}} (C, P_I/P_{rest}, P_f) \qquad \text{(VI.4)}$$

Since the order of this allocation is not of much relevance to an analysis of demand for manufactured products, a specification of the second type is used below.

A 'direct' approach

Alternatively, the shares of the various commodity groups in consumption can be determined jointly.

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[5]Krishnaji (1984), in his analysis of consumption from 1960-61 to 1980-81, shows that the elasticity of demand for non-food commodity groups with respect to cereal price is negative. Further, he distinguishes between households for whom consumption of food is a priority item, and those whose income levels are high enough to ensure satiation in food consumption. In such a case, an increase in cereal price (or foodprice) could well lead to a decline in the consumption of other commodities in the aggregate.

$$C_I = C_I (Y_d, P_f, P_I, P_{rest}, r) \qquad \text{(VI.5)}$$

The choice of deflators is important here, as are relative prices; a special case involves the agriculture-industry terms of trade, or the ratio of manufacturing price to the food price. To incorporate the effects of a very fast growing tertiary sector, the ratio of GDP originating in the primary and non-primary sectors can be used as a conditioning variable. The significance of such a variable may well stem from the consequence of the growth of incomes at the high end, and thus account for a change in the structure of demand.[6]

The importance of the price of food in the determination of demand for industrial output requires careful exploration. A lower price of food should have substantial income effects that are likely to increase consumption of other commodities; at the same time, the incomes of net surplus producers are likely to decline. In the 1980s, it was quite likely that the disproportionate increases in food and fertiliser subsidies counterbalanced the latter tendency.

In two-stage budgeting, the second stage is based on group expenditure and prices within the group. Two-stage budgeting is valid only if the results of the second stage are identical to what would occur if the allocation was made in one step with all relevant information.[7]

The ideas of the separability of preferences and two-stage budgeting are intimately related but not equivalent. However, weak separability of

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[6]Lahiri, et al (1984) and Pandit (1992) adopt a similar approach.

[7]Deaton and Muellbauer (1980) Ch. 5 provides a thorough discussion of two-stage budgeting, separability, and the relationship between the two.

preferences is necessary and sufficient for the second stage of such a division of the process of consumer choice into two steps.[8]

In modelling consumption demand for industrial output, the first stage involves the determination of the level of overall consumer demand - the familiar notion of a consumption function. The second stage involves the allocation of the previously determined level of consumption between different commodity groups, thereby determining consumption of industrial output. The validity of such a division into two stages is established by considering consumption of industrial products as a function of income in one step including the price of manufactured goods relative to food. A comparison of the two-stage specification for consumption of manufactures with the specification derived in one-step provides an indirect test of the existence of weak separability. Weak separability can be justified if the specifications are more or less identical.

A brief outline of recent consumption function approaches

Both received theory and current research on estimation of aggregate consumption functions suggest that the life cycle theory of Ando and Modigliani (1963) combined with the permanent income hypothesis first espoused by Friedman (1957) offers a starting point for a fruitful analysis of non-durable consumption expenditures. It is generally acknowledged that it is more difficult to model the empirics of the consumption of durables,

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[8]Weak separability can be said to be satisfied when the utility function u can be written as:

$$u = v(q_1, q_2, q_3, q_4, q_5, q_6) = f\{ v_a(q_1, q_2), v_b(q_3, q_4), v_c(q_5, q_6)\}$$

where f is an increasing function, and v_i are subutility functions associated with the groups that the commodities belong to. See Deaton and Muellbauer (1980), pp. 122-4.

primarily because of the difficulty of measuring the flow of benefits from such long-lived commodities. Largely because of the form in which reliable statistics are available, this distinction will be glossed over in this study.[9] The justification for not pursuing this and other such refinements is my concern with obtaining a general characterization of the demand for industrial products rather than specifically investigating the dynamics of consumption in which such nuances acquire far greater importance. As mentioned elsewhere in this dissertation, the constraints placed by the data available do not permit this distinction to be made.[10] As demonstrated below, this does not become problematic, as consumption of durables is limited.

With this caveat in mind, the simplest permanent income-life cycle hypothesis can be represented as:

$$C = k\,(\rho)\,(\Omega + \Psi) \qquad \text{(VI.6)}$$

where Ω is a measure of wealth, physical and financial, k is a factor of proportionality, ρ is the long-run real rate of return, and Ψ is the discounted present value of current and future non-property incomes. All variables are measured in real terms, though an independent role can be

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[9]von Ungern-Stenberg (1981) considers aggregate consumption for Germany including consumer durables due to the non-availability of data. The results he obtains appear quite satisfactory.

[10]Here, the issue of durable as opposed to non-durable consumption joins the "five (other) potentially important influences" mentioned in Hendry, et al (1990) (pp. 301) which will not be explicitly considered in our study. These are: 1. income uncertainty; 2. credit constraints; 3. demographic changes; 4. liquidity; 5. dynamic adjustment. Of course, some consideration of dynamics is necessarily a component of the "general to specific" modelling methodology adopted here.

envisioned for price change in influencing consumption. This equation can be represented, after suitable approximation,[11] as:

$$c = \phi_0 + \phi_1 \rho + \phi_2 \psi + \phi_3 (\Omega / \Psi) \qquad \text{(VI.7)}$$

The study of the consumption function by DHSY (1978) has been crucial in the popularization of the "general to specific" modelling methodology as a way of investigating empirical relationships in economics, and the widespread use of ECMs in consumption studies, later explained as a response/outcome of cointegrating relationships, also owes to this area of research.[12]

A different specification for private final consumption expenditure (pfce) suggested by Ungern-Sternberg (1981) in the context of Germany and the UK is of the form:

$$\Delta pfce_t = \kappa + \beta_1 \Delta y_t + \gamma (c_{t-1} - y^*_{t-1}) + \nu_t \qquad \text{(VI.8)}$$

where $y^*_t = \log (Y_t - \delta p^e_t M_{t-1})$

p^e_t [$= (p_t - p_{t-2})/2$] is chosen as a proxy for the perceived rate of inflation, and M provides a measure of monetary assets.[13] This is little different from the equation above, apart from the fact that the inflation term is

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[11]See Hendry, et al (1990).

[12]Hendry, et al (1990) provides an update on the status of the DHSY (1978) consumption function, besides listing theoretical and empirical developments since 1978. More recently, Carruth and Henley (1990), investigate the validity of the DHSY type specification for the UK in the 1980s.

[13]von Ungern-Sternberg (1981) defines M as follows: for Germany, M = Bank Deposits + building society Deposits - bank loans - mortgage loans. For the UK, M = National Savings + Deposits with banks and building societies - bank advances - mortgage loans.

given an explicit behavioural interpretation, and M is chosen as a measure of wealth.

With inflation the real value of monetary assets may decline, and this can be seen as a cause of a decline in perceived levels of income, but not in measured levels of disposable income. This is incorporated by effecting the adjustment on disposable income; this adjustment is not to be confused with real balance effects which need to be modelled separately. The success of this model in accounting for the secular decline in the consumption to income ratio in the UK and Germany in a period of unprecedented inflation suggests that it could be useful in accounting for the increase in the savings ratio in India, apart from explaining the general dynamics of consumption.

I use disposable income derived by combining the estimates of consumption expenditures and those of saving as the basis for analysing consumption expenditure. I considered using a disaggregated set of income variables as a means of capturing the diversity between sectors in a period of structural change and development. Since the different sectors have different tax rates, it becomes difficult to incorporate them in this form, and I did not use any such distinguishing device. However, a distributional variable that is based on the proportion of GDP originating in the three sectors is employed. I differentiate between primary and non-primary income, in the style of Lahiri, et al (1984) and apply that ratio in the equation that involves disposable income.

The choice of a measure of wealth or an asset variable has to take into account conceptual issues, statistical features and, as in everything else, the availability of data. The distribution of income is significantly skewed, and the holding of wealth is even more concentrated. However, some

kinds of assets are far more widely held than others; liquid assets seem to be more suitable than other forms of wealth-holding as an aid to understanding the links between wealth and consumption due to the wide dispersion of liquid asset holding.[14] There are other potentially important considerations in using liquid assets as a proxy of wealth - there could be a long term trend in the composition of wealth-holding which renders the use of a single subset of wealth unrepresentative of the whole, and there could also be a drift in the ratio of wealth to income. Certainly, the liquid assets to income ratio has increased, but so too has the ratio of measured savings of households to their income.

Unfortunately, the criteria used to distinguish between time deposits and demand deposits were altered in the period I consider, making it impossible to obtain a consistent series for liquid financial assets held with the banking system. Consequently, I used the total of all bank deposits as a measure of wealth, using the ratio of total bank deposits to disposable income as an explanatory variable in my model.[15]

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[14]Clearly, for those who have assets in India, liquid assets are the most easily quantifiable, as well as the most widely held financial assets.

[15]The changes in the classification of time and current deposits in this period do not permit the use of a distinction between liquid and non-liquid assets as far as measurable monetary wealth holding is concerned.

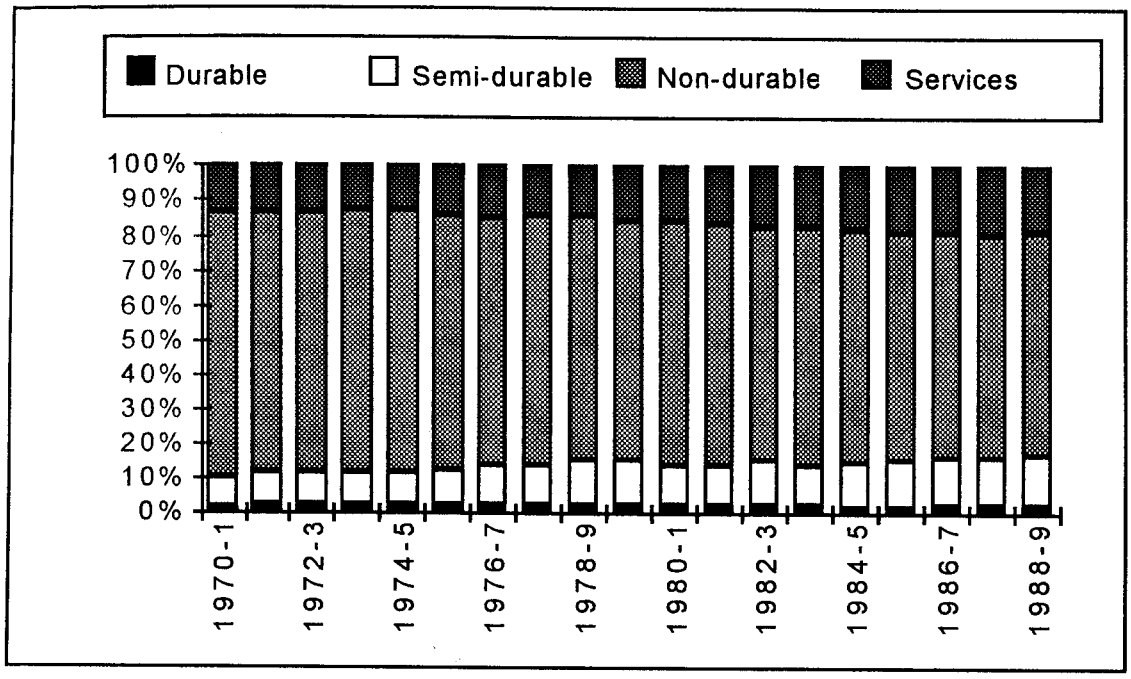

Figure VI.i : Private final consumption expenditure by category (1980-81 prices). Source: NAS (various issues)

The issue of durable versus non-durable consumption is complicated by the non-availability of figures, as well as the inclusion of a third category of semi-durables in the statistics for consumption. While there is no option but to carry out the exercise with the figures for aggregate consumption, it is of some comfort to note that, for the period since 1970-71 for which disaggregated figures are available, non-durable consumption forms by far the greatest bulk. Even in 1988-89, inspite of a secular decline in the proportion of consumption accounted for by non-durables, this is a very large 98.02% (down from 98.56% in 1970-71).[16]

[16]Even if the category of semi-durables is included in a generous definition of durables, the proportion of consumption that is accounted for by non-durables increased from 90.26% in 1970-71 to 83.41% in 1988-89.

However, this aggregate consumption function relates to all consumables, while my interest lies in demand for industrially produced consumer goods. While figures on consumption of manufactures by industry of origin are not available, the non-cereal, non-services component of private final consumption expenditure provides a reasonable proxy for this variable. In modelling the demand for this variable that the disaggregation of the aggregate income variable by sector would have been useful, given that differences in average incomes and propensities to consume between primary and non-primary sectors are likely to be appreciable.

In line with the approach outlined above, a two-stage budgeting approach is followed to first estimate a consumption function, to identify the major influences on private consumption, and check for structural breaks and regime changes. In the second stage I look at the influences on the allocation of this consumption demand for manufactures. I then attempt to combine the two stages to produce an single-step demand specification for private consumption demand for manufactures.

A consumption function for India

I develop a consumption function in the tradition of Davidson, et al (1978) to model aggregate private consumption expenditure. The differences in the Indian experience, and, to restate an old theme, the distinct nature of the data available necessitate some innovation.

Table VI.1: Integration statistics

Variable	D.W.	D.F.	A.D.F.
c	0.0552	-1.102	-0.185
y	0.0575	-2.277	-1.22
ci	0.0323	0.1062	0.3992
p	0.014	6.42	3.2
Δp	1.326	-2.51*	-2.22*
l(D/Y)	0.0279	1.283	1.115
P_m/P_f	0.486	-2.096	-2.551
SR	0.0588	-2.385*	-3.162**

1952-53 to 1988-89, 37 observations. D.W. = Durbin-Watson test statistic, D.F. = Dickey-Fuller test statistic, A.D.F. = Augmented Dickey Fuller test statistic. For variables that incorporated a time trend, the test statistics were evaluated including a trend. Evaluated using PC-GIVE 7.0. * indicates significance at the 5% level, and ** at the 1% level.

The tests for the order of integration of the series above establish that all the series with the exception of the sectoral income ratio variable (SR) and the inflation term (Δp) are I(1). The exceptions represent series for which the hypothesis of a unit root is rejected.

I examine the cointegration of c_t with y_t and Δp_t, and establish the value of the coefficient on income in an EC term. Following this, I develop a parsimonious representation from an unrestricted general model, and

using recursive techniques and within-sample forecasting tests, establish the constancy of the estimated model.

The model estimated is of the form:

$$\Delta c_t = \beta_0 + \beta_1 \Delta y_t + \beta_2 \Delta p_t + \beta_3 (c_{t-1} - \chi y_{t-1}) + \beta_4 \Delta l(D/Y)_t + \nu_t \qquad \text{(VI.9)}$$

where D stands for bank deposits in real terms. Different interest rates - long-run and short-run - were also included in the general specification in turn. Not surprisingly, these were not significant.[17]

As a preliminary, the variables c_t, y_t and Δp_t were examined for the existence of cointegrating vectors using the Johansen Maximum Likelihood method.[18] A second order vector autoregression was estimated including a constant, and the eigenvalues of the long-run matrix π and its factorization into the matrices α and β' yielded, for the eigenvalues of π:[19]

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[17]Pandit (1991) suggests that interest rates are unlikely to have a very significant impact on consumption. Given that borrowing has little impact on consumer spending, and that liquidity constraints are quite universal, this is not entirely suprising.

Unofficial lending, usually from moneylenders, continues to play a role in financing consumer spending of various kinds. Such unofficial lending is usually made on the basis of a reasonable knowledge of the creditworthiness or otherwise, of the borrower, who is usually in distress, and could be made at virtually any rate of interest, ranging from 0% to 200% annually. In any case, estimates of the extent of such activity are, by their very nature, unreliable.

[18]See Johansen (1988), Johansen and Juselius (1990) and Johansen (1992), as well as Hendry, et al (1990).

[19]Since a constant was included, critical values from Johansen (1992) were used.

j	μ_j	-T log(1-μ)	TΣ log(1-μ_j)
1	0.0609	2.262	2.262
2	0.0986	3.737	5.999
3	0.4493	21.479	27.478

(1951-52 to 1988-89)

The null of no cointegrating vectors can be rejected in favour of one cointegrating vector, but the null of one cointegrating vector cannot be rejected, even in the small sample considered.

The matrix of (standardized) cointegrating weights β' is:

Variable	c_t	y_t	Δp_t
c_t	1.00	-0.85	0.10
y_t	-2.89	1.00	-0.80
Δp_t	-0.28	0.05	1.00

The corresponding response (feedback) coefficients (the α matrix) are:

Variable	c_t	y_t	Δp_t
c_t	0.027	-0.028	-0.096
y_t	0.293	-0.026	-0.203
Δp_t	-0.314	0.126	-0.813

The values of the test statistics suggest that there is only one cointegrating vector, between c_t, y_t and Δp_t. The row for c_t implies a cointegrating equation of the form:

$$c^*_t = 0.85\ y^*_t - 0.1\ \Delta p^*_t \qquad \text{(VI.10)}$$

Estimating the long-run relationship between c_t, y_t and Δp_t using an ADL yields:[20]

[20]The first step of the Engle-Granger (1987) two-step procedure to estimate the ECM involves the estimation of such along run relationship in levels, without any consideration of dynamics. Such an equation is frequently misspecified, as in the example above, but is useful in investigating possible cointegration relationships, as well as identifying one of a potentially large number of cointegration vectors.

Table VI.2: Long-run consumption relation (Dependent variable : c_t)

Variable	constant	c_{t-1}	y_t	y_{t-1}	Δp_t	Δp_{t-1}
Coefficient	0.16	0.78	0.73	-0.54	0.02	0.04
H.C.S.E.	0.13	0.13	0.07	0.11	0.07	0.05

D.W. = 2.21; Adjusted R^2 = 0.74; σ = 1.48%. (OLS estimates for annual data 1952-3 to 1988-9.)

The corresponding static long run equation is:

$$c^*_t = \underset{(0.40)}{0.70} + \underset{(0.08)}{0.83\, y^*_t} + \underset{(0.32)}{0.24\, \Delta p^*_t} \qquad \text{(VI.11)}$$

(standard error)

(Wald test χ^2 (3) = 132636.6).

The Wald test statistic reveals that the variables are jointly highly significant, but the coefficient on inflation does not appear to be well determined.[21] The Johansen Maximum Likelihood procedure and the long-run relationship estimated support the existence of a long-run equilibrium relation between consumption and disposable income. The coefficient value of 0.85 for disposable income is used in modelling consumption in an error correction form.

Following a general-to-simple strategy, various influences such as the interest rate, food prices and the ratio of non-primary sector income to all

[21] Inspite of the poorly determined coefficient in this long-run equation, the inflation term is included in the consumption function below. As the cointegrating combination of c and y is used as a regressor, this allows potential problems created by multicollinearity to be overcome.

income were incorporated in the general model.[22] The limited span of the data set, and the availability of only annual figures limited the use of lags greater than one period in the unrestricted model.[23] The reduced final version of the model is:

Table VI.3: ECM equation for consumption (Dependent variable : Δc_t)

Variable	κ	Δy_t	$(c-0.85y)_{t-1}$	Δp_t	$\Delta l(D/Y)_t$
Coefficient	0.280	0.595	-0.440	-0.122	-0.140
t-value	3.48	7.57	-3.38	-2.22	-3.47

D.W. = 1.72; Adjusted R^2 = 0.92; σ = 1.31%. (RLS estimates for annual data 1951-2 to 1988-9 less 3 forecasts.)

Chow F (3, 30) = 1.28; Normality χ^2 = 1.12; AR 1-3 F (2, 26) = 0.45; ARCH 3F (1, 26) = 0.52; Heteroscedastic errors F (8, 21) = 1.01; Forecast χ^2 (3)/3 = 1.48.

The t-values for the 1-step forecasts are :

(Date)	1986-87	1987-88	1988-89
(t-value)	1.69	-0.06	1.06

[22]The ratio of incomes arising in the different sectors is based on the GDP arising in the various sectors, and may well be different from a similar ratio for disposable incomes. The limited data on tax ratios at a sectoral level militated against a clearer correspondence between the two variables being achieved in our model.

[23]Even if degree of freedom considerations were relatively unimportant, it seems unlikely that greater lags would have proved useful or significant. In the event, the performance of the model suggests that the *a priori* thinking was justified.

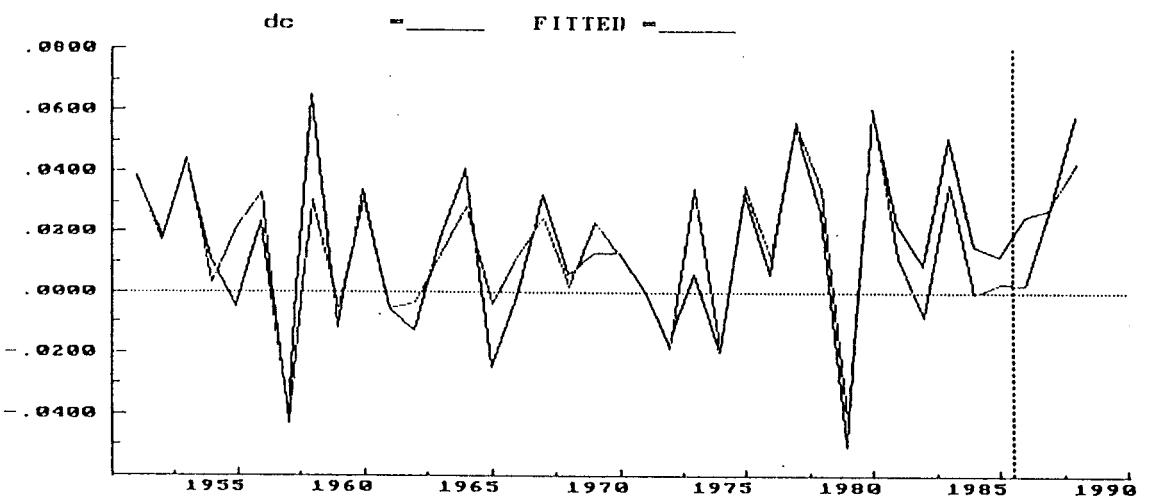

Figure VI.ii: Aggregate consumption function - actual and fitted values

The estimated equation passes the mis-specification tests comfortably. The out of sample forecast performance is acceptable, taking into account the limited degrees of freedom. Recursive estimation confirmed the constancy of the parameter values, as the graphs of the sequences of the scaled one-step, break-point, and forecast Chow tests demonstrate.

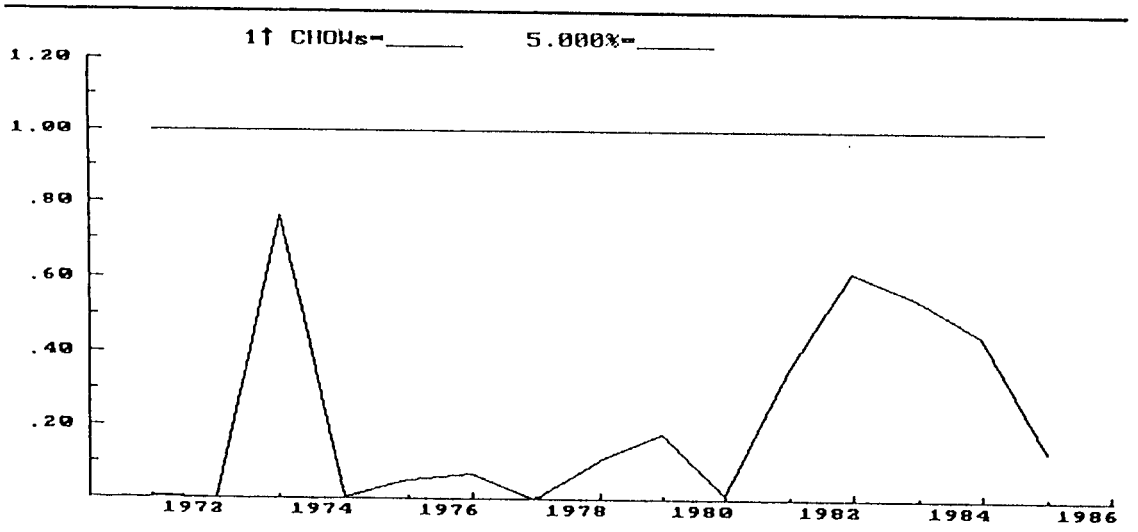

Figure VI.iii: Sequence of one-step ahead Chow tests for the aggregate consumption function.

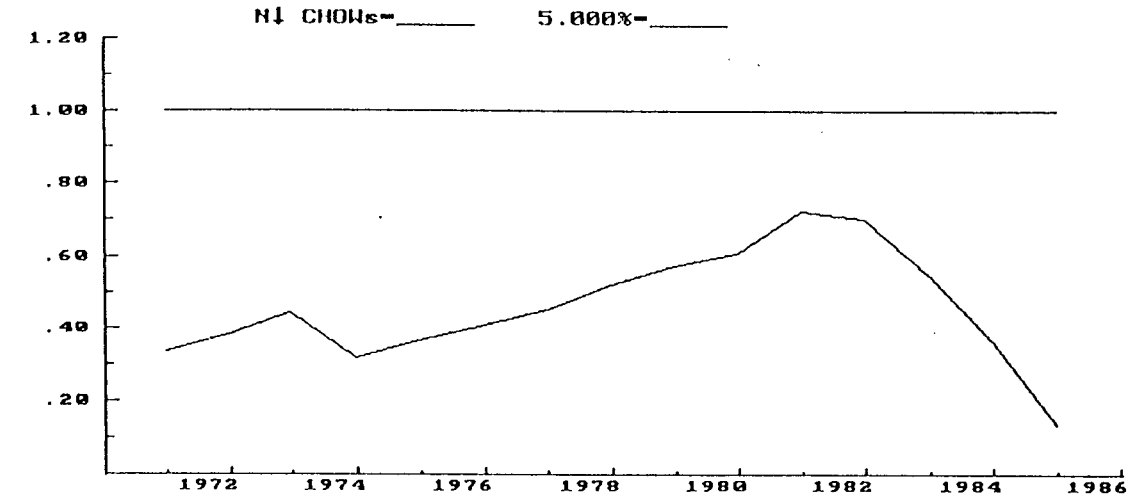

Figure VI.iv: Sequence of break-point Chow tests for the aggregate consumption function.

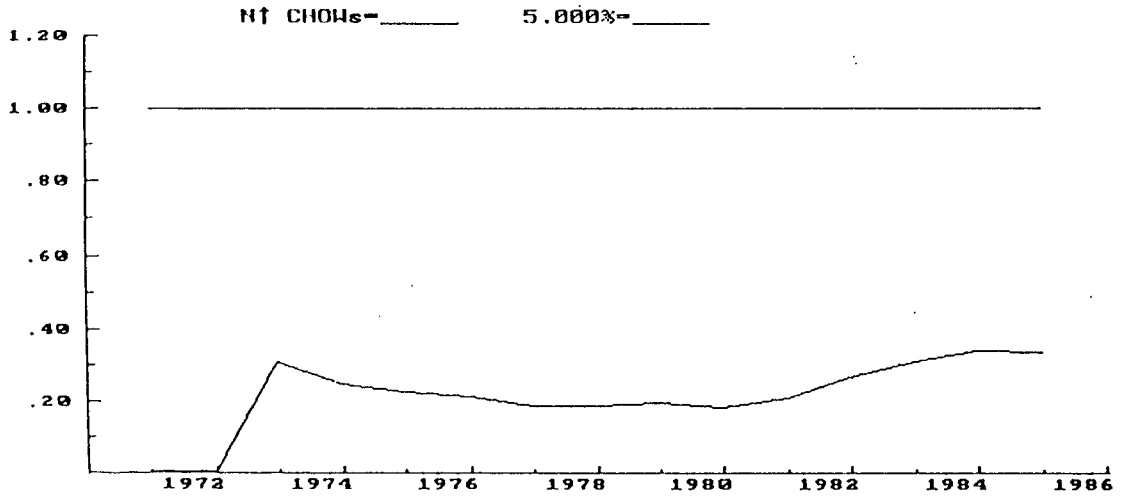

Figure VI.v: Sequence of forecast Chow tests for the aggregate consumption function.

The negative error correction coefficient supports an equilibration interpretation of the EC term, and the negative coefficient of the change in prices, is along lines that would be expected. The negative sign of the coefficient for the deposit to income impact term [$\Delta l(D/Y)_t$] is somewhat difficult to explain. An increase in this term could possibly signify a

higher level of saving, and therefore a lower level of consumption in that particular period. Also, the deposit to income ratio could be boosted by unexpectedly low inflation in the short-run.

The satisfactory performance of this consumption function provides a basis for proceeding with a model of consumption that focuses on manufactured consumer goods.

Private consumption of manufactures

Following a two-stage budgeting approach, I develop a model of consumption demand for manufactures. A prior decision on the extent of all consumption is then influenced by the interaction of other variables. To illustrate this, I look separately at the consumption of industrial products, having already set out a model of aggregate consumption. Following this, I develop a model that combines the two steps in a single-stage specification of the consumption demand for industrial commodities.

To model the second stage of the consumption demand for industrial goods, I estimated a model of ci, conditioning on c rather than y. The model of ci in relation to c included the relative price of manufactures relative to food, the relative proportions of primary sector to non-primary sector income (SR), the inflation rate and the D/Y term. The SR term incorporates a trend. The final parsimonious form of the equation is reported below.

Table VI.4: Consumption demand for industrial output (Dependent variable : Δci_t)

Variable	κ	Δc_t	Δp_{t-1}	$\Delta(Pm/Pf)_{t-1}$	SR_t	$\Delta l(D/Y)_t$
Coefficient	0.044	0.653	-0.144	-0.048	-1.668	0.062
t-value	2.05	6.47	-2.85	-2.15	-1.67	1.81

D.W. = 2.49; Adjusted R^2 = 0.84; σ = 1.39%. (RLS estimates for annual data 1952-53 to 1988-89 less 3 forecasts.)

Chow F (3, 28) = 0.51; Normality χ^2 = 0.91; AR 1-3 F (2, 25) = 0.86; ARCH 3F (3, 22) = 1.50; Heteroscedastic errors F (10, 17) = 0.73; Forecast χ^2 (3)/3 = 1.67.

The t-values for the 1-step forecasts are :

(Date)	1986-7	1987-8	1988-9
(t-value)	0.26	0.14	1.24

The coefficients have the expected signs, with the exception of the deposit-income ratio, which has a positive sign, different from the overall consumption function. The change in the relative price of manufactured goods to food affects the allocation of income to manufactured products with a lag, as does the overall consumer price index.

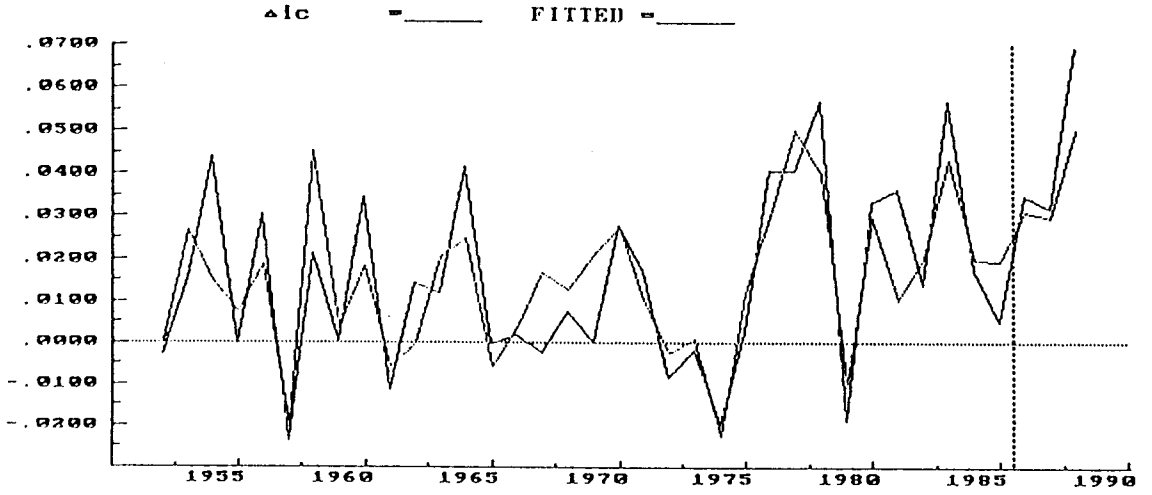

Figure VI.vi: Model of industrial consumption as a function of all consumption - Actual and fitted values.

A possible explanation for the sign on the D/Y term is a shift of consumption patterns towards manufactured goods, including durables, as the ratio of deposits to income rises. This model of the allocation of a certain amount of consumption to manufactures suggests that a rise in the deposit to income ratio, which may indicate some kind of wealth-effect, raises demand for consumer goods produced by industry.

The mis-specification tests indicate that the model is well-specified, though the value for the Durbin-Watson statistic is a little high, indicating residual autocorrelation.

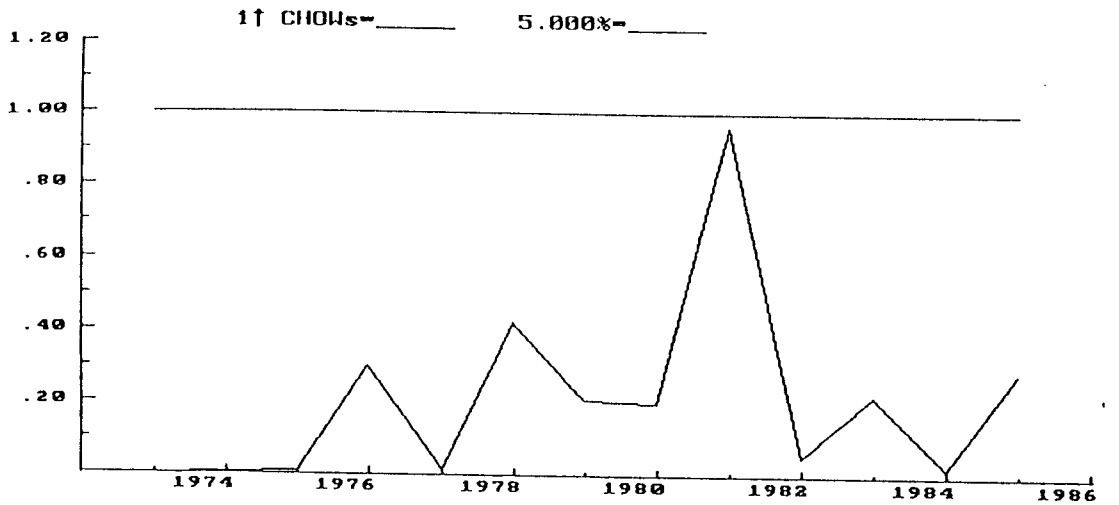

Figure VI.vii: Model of industrial consumption as a function of all consumption - Sequence of one-step Chow tests.

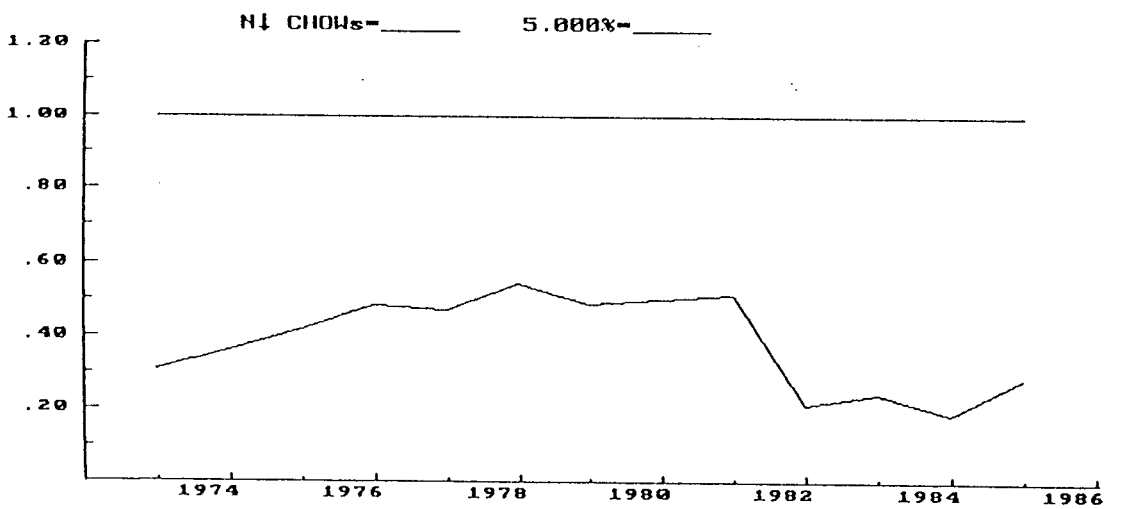

Figure VI.viii: Model of industrial consumption as a function of all consumption - Sequence of break-point tests.

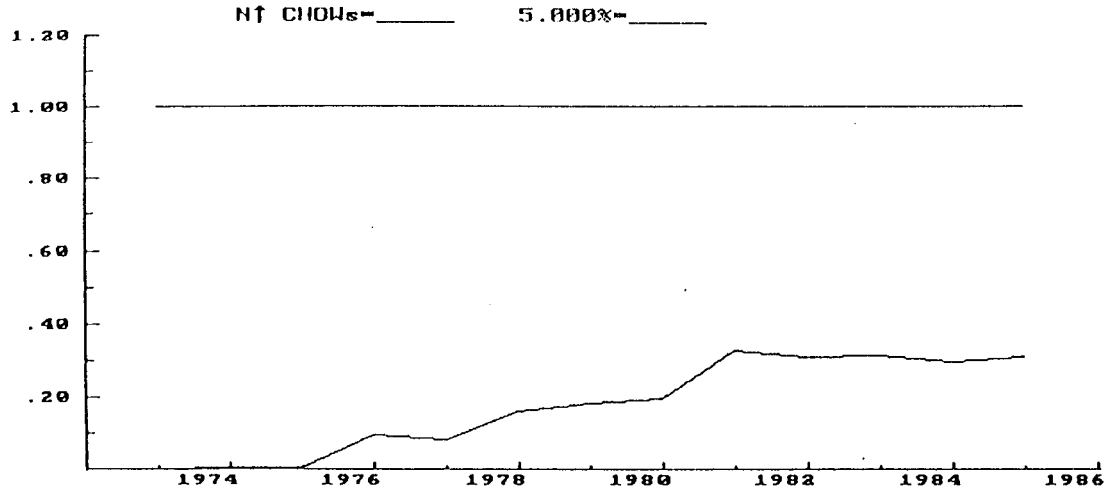

Figure VI.ix: Model of industrial consumption as a function of all consumption - Sequence of forecast tests.

The recursive tests indicate that the parameter values are stable.

A consumption function for manufactures

The results obtained in the case of the consumption function and the model for the consumption of manufactures in relation to all consumption indicate the possibility of combining the two in a single equation in which consumption demand for industrial commodities is directly related to income, relative prices and wealth. In specifying such a model that relates consumption of industrial products to income, prices (relative prices as well as changes in the overall price level), wealth and changes in the sectoral composition of aggregate income, I rely on the existence of a long-run relation between ci_t and y_t.

The Johansen method of investigating for cointegration between ci and y yields the following matrix of eigenvectors:

	y	ci
y	1.00	-0.511
ci	-0.935	1.00

The eigenvalues are 0.1098 and 0.1703, which yield -T log $(1-\pi_i)$ = 4.30 and 6.91. The hypothesis that there are no cointegrating vectors cannot be rejected on the basis of the cointegration rank test statistic at the 5 per cent level. However, the row for ci provides a long-run relation of the form:

$$ci^*_t = 0.935\ y^*_t \qquad \text{(VI.12)}$$

Given the small size of the sample, I investigated the possibility of cointegration further, using a long-run equation derived from an ADL involving ci and y that provided the following results:

Table VI.5: Long-run relation for consumption of manufactures

(Dependent variable : ci_t)

Variable	constant	ci_{t-1}	y_t	y_{t-1}
Coefficient	-0.25	0.82	0.50	-0.29
H.C.S.E.	0.10	0.08	0.07	0.08

D.W. = 2.04; Adjusted R^2 = 0.52; σ = 1.63%. (OLS estimates for annual data 1951-2 to 1988-9.)

The corresponding static long run equation is:

$$ci^*_t = \underset{(0.66)}{-1.34} + \underset{(0.13)}{1.13}\ y^*_t \qquad \text{(VI.13)}$$

(standard error)

(Wald test χ^2 (2) = 27821.2).

The residuals from this equation were tested for the existence of a unit root using the D.F. and A.D.F. tests. The values for the test statistics (6.67 and 7.99 respectively) comfortably reject the null of non-cointegration. Employing an error-correction term in the equation below confirms this, as does the graph of the residuals from the long-run equation.

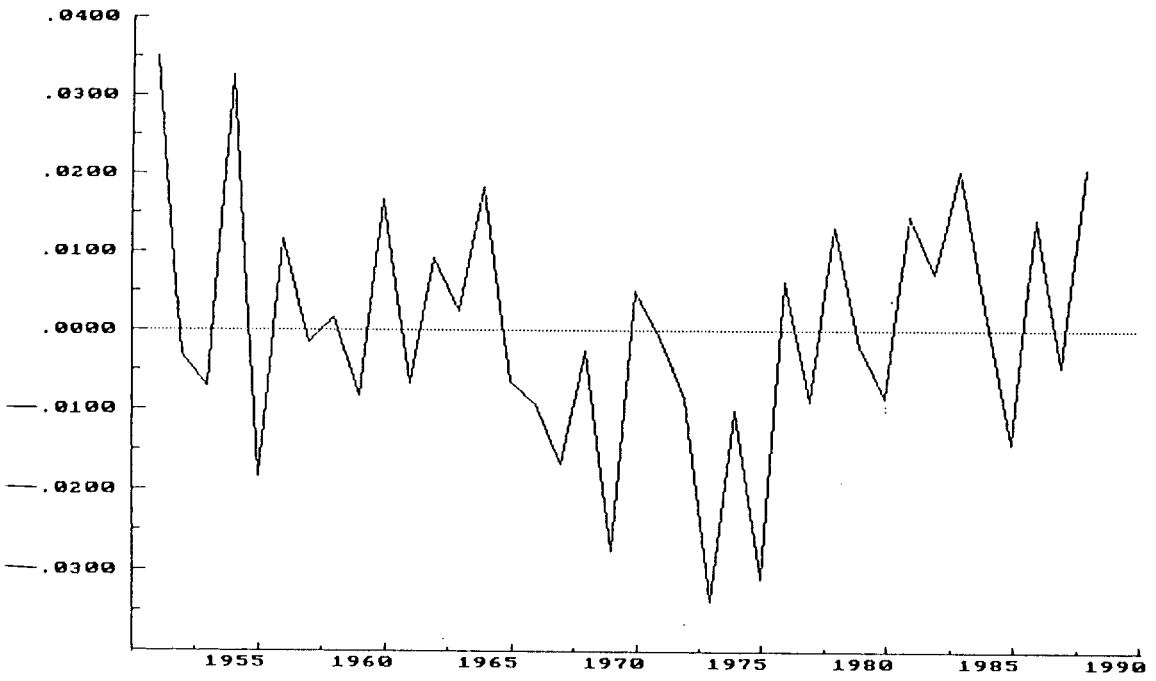

Figure VI. x: Residuals from static long-run equation involving ci and y.

Table VI.6: Consumption demand for industrial output (Dependent variable : Δci_t)

Variable	κ	Δy_t	$(ci-y)_{t-1}$	$\Delta(Pm/Pf)_{t-1}$	SR_t	Δp_{t-1}	$\Delta l(D/Y)_t$
Coefficient	-0.106	0.538	-0.241	-0.028	-0.111	-0.168	-0.097
t-value	-1.32	5.97	-2.42	-1.19	-2.17	-2.52	2.01

D.W. = 2.17; Adjusted R^2 = 0.82; σ = 1.47%. (RLS estimates for annual data 1952-53 to 1988-89 less 2 forecasts.)

Chow F (2, 28) = 0.43; Normality χ^2 = 0.22; AR 1-3 F (3, 25) = 1.62;

ARCH 3F (3, 22) = 1.77; Heteroscedastic errors F (12, 15) = 0.59;

Forecast χ^2 (2)/2 = 0.49.

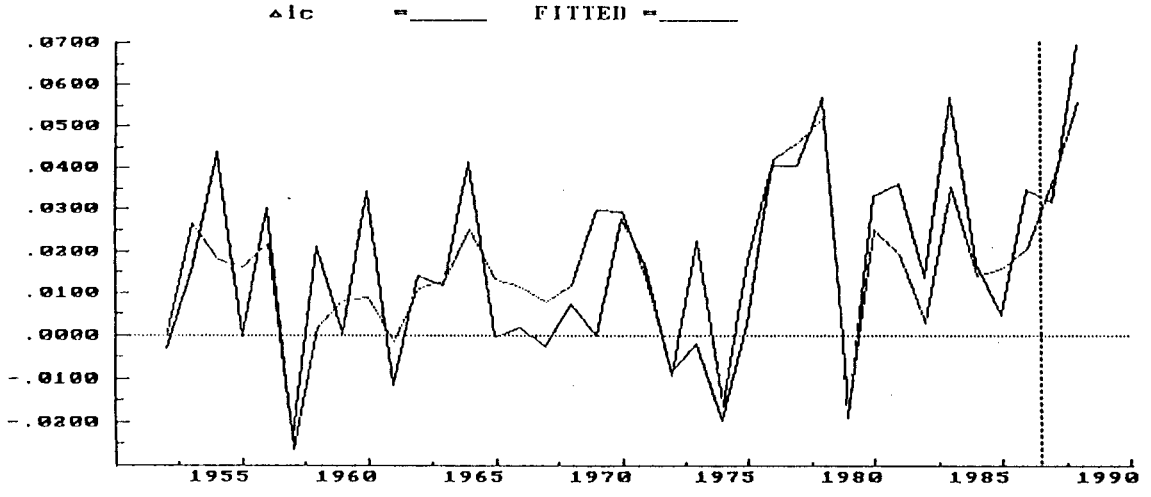

Figure VI.xi: Consumption function for industrial products - Actual and fitted values.

The t-values for the 1-step forecasts are :

(Date)	1987-88	1988-89
(t-value)	-0.31	0.79

The model has parameters in line with what would be expected on the basis of the results for the previous two equations. The specific dynamics are different from the overall consumption function, with lags on the price terms. The coefficients for both the change in the overall level of prices and the change in relative prices appear to be less than well determined. This is probably a cause of the somewhat reduced explanatory power of this model in comparison to the model for consumption of manufactures out of all consumption.

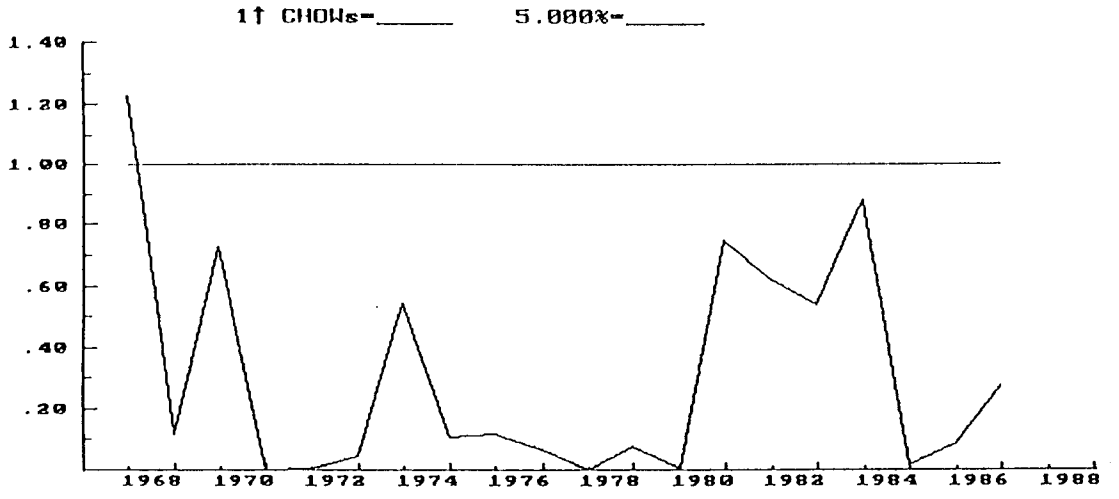

Figure VI.xii: Consumption function for industrial products - Sequence of one-step Chow tests.

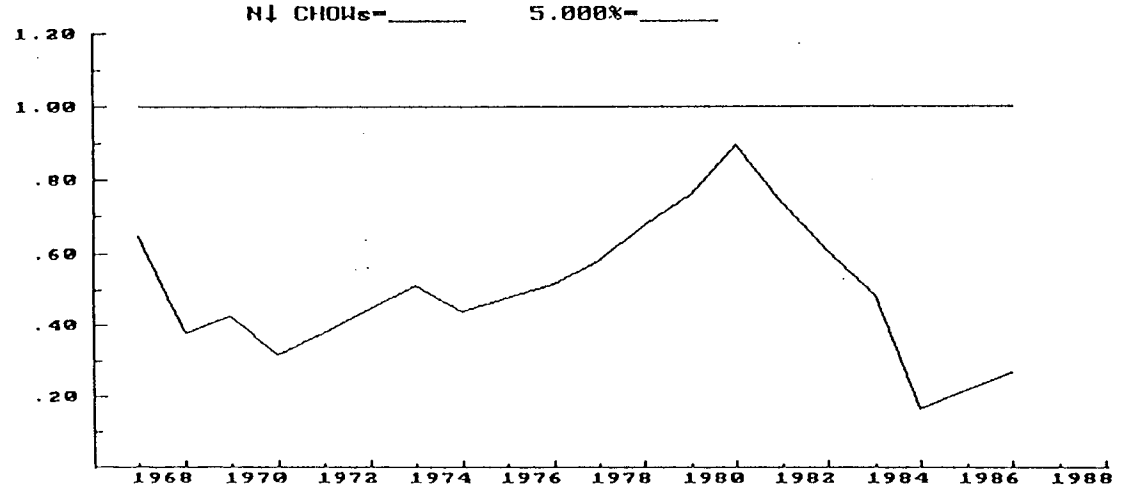

Figure VI.xiii: Consumption function for industrial products - Sequence of break-point tests.

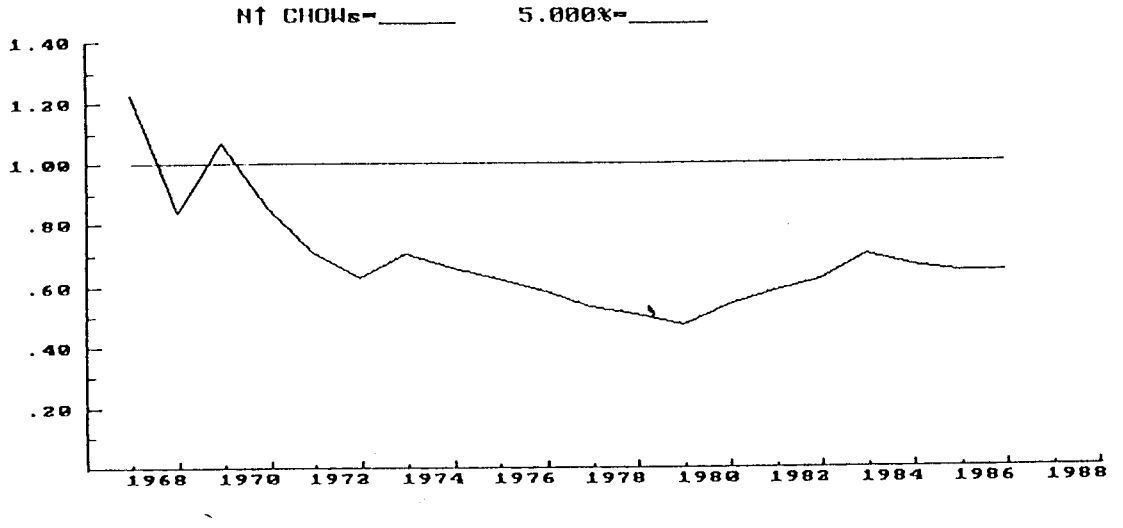

Figure VI.xiv: Consumption function for industrial products - Sequence of forecast Chow tests.

The recursive tests establish that the forecast performance of this specification is more than adequate throughout the 1970s and the period of acceleration in the 1980s. The evolution of the coefficient on the deposit to income ratio, both in terms of its size and its increasing significance, is an indicator of the nature of the changes in the structure of consumption that characterised the 1980s.

The similarity of the two specifications for consumption of manufactures support weak separability. To illustrate this, I derive the signs of the direct estimate of consumption demand for manufactures on the basis of the two-stage approach. The variables in the final parsimonious specification are the same, and the signs of the coefficients of the direct estimate are in line with what a combination, ignoring dynamics for a moment, of the two stages of the indirect approach would suggest.

Table VI.7: Signs of estimated coefficients

	y	Δc	Δ(Pm/Pf)	SR	Δp	Δ(D/Y)
c function	+				-	-
ci (2nd stage)		+	-	-	-	+
ci (direct)	+		-	-	-	?

The sign of the coefficient on the Δl(D/Y) term in the direct specification is not in conflict with that suggested by the two-stage estimate. The size of the negative coefficient (-0.140) in the consumption function is greater than the magnitude of the coefficient on this term (0.062) obtained in the second stage function, and it is therefore not entirely suprising that the coefficient in the direct specification (-0.097) is negative.

Why did the consumption demand for manufactures grow?

It seems clear that there were inexorable tendencies increasing demand for manufactured consumer goods. These tendencies were probably accelerated by an increase in monetary assets in relation to incomes. Government policies in the 1980s promoted a great increase in liquidity and monetary assets, and this may well have been responsible for the increased demand of manufactured consumer products. At the same time, the trends in terms of increased consumer prices and higher prices of manufactured goods relative to food prices, may have exercised a braking effect on consumer demand.

Establishing that there is a relatively constant function relating the demand for manufactures for consumption to income levels in dynamic terms still leaves open the question open as to what factors initiated

income expansion in the economy as a whole. But this is a chicken and egg question, and in the latter part of the period considered in this thesis, the accelerated increase in the size of the tertiary sector, in proportional terms, could well have increased the sensitivity of industrial expansion to changes in overall income.[24]

I move on in the next chapter to a consideration of investment demand for industrial output to complement the discussion of consumption demand undertaken here. An evaluation of the influence of government expenditure is a crucial component of the investigation of investment demand.

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[24]Kumar (1991) argues that the services sector is characterised by the existence of higher levels of unreported incomes, and a higher proportion of such income are spent on consumer goods than is the norm. An increase in the share of the services sector would increase the elasticity of consumer expenditure to overall income.

VII

INVESTMENT DEMAND

The other significant component of demand for industrial commodities, apart from consumption, arises from investment and capital formation.[1] This chapter develops a model for the demand for machinery and equipment (investment goods produced in the manufacturing sector) that arises in the private sector. Public sector demand for investment goods is viewed as being exogenously determined in the context of this model.

A further motivation for modelling equipment investment derives from its importance in influencing overall growth by means other than stimulating aggregate demand. It has been demonstrated that differences in rates of investment in machinery and equipment have a strong influence on differences in rates of growth across countries. This conclusion has been shown to be robust regardless of the other factors used in trying to account for such differences in international growth rates.[2]

The subject of influences on investment has received considerable attention in the context of developed economies, but comparatively little information is available on developing countries. For one, the circumstances in developing economies violate the assumptions of most

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[1] A general discussion of appropriate models for the consideration of issues relating to investment: putty-clay models with uncertainty and irreversibility; flexible accelerators; inventory and stock-building behaviour; capital-stock adjustment; credit constraints and the cost of capital.

[2] De Long and Summers (1991, 1992) highlight the critical role of equipment investment in contrast to that of non-equipment investment in accounting for international variations in the growth experiences of a group of developed countries between 1960 and 1985.

models developed in the context of advanced economies, and econometric exercises to isolate the prime determinants of investment have to take account of the distinguishing features of developing economies. The discretion over investment decisions that the state possesses, and the overall regulation of capital markets and sources of finance are major characteristics that play little part in the determination of investment in developed economies, and these are significant elements of the investment process in a developing country such as India. Analysis of the investment process is perhaps inevitably restricted to the private sector, though the influence of the state must be incorporated. Also, the relationship of public to private investment is a dominant element of this process of capital formation, and one that can be modelled, amenable to modelling.[3]

My analysis of demand for capital goods in India relies on treating public investment as exogenous, and identifying the major influences on private capital formation. The relationship between public and private investment is probably the most important element of this investigation, not least because of the increasing emphasis on private investment as a means of achieving growth, and the conscious diminution of the proportion of investment accounted for by public sector outlays in

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[3]For a survey, see Tun Wai and Wong (1982) and Blejer and Khan (1984) for approaches to the study of private investment in developing countries. Sundararajan and Thakur (1980) focus on Korea and India. Pfefferman and Madarassy (1992) provide an overview of trends in investment in developing countries, and Greene and Villanueva (1991) identify macroeconomic variables that are correlated with the rate of private investment in the context of 23 developing countries between 1975 and 1987.

Shafik (1992), in a study of private investment in Egypt, adopts an approach which is startling in its similarity to the one adopted in this dissertation.

successive Five-Year Plans.[4] Private capital formation in machinery and equipment is only one component of investment, and ignoring the outlays on construction is a consequence of the focus on the manufacturing sector, in narrow terms, rather than a reflection of economic insignificance.

As a first step, the model of Bean (1981) is presented here. This variation of the usual neo-classical model for the determination of the optimal level of capital stock relates the level of capacity to the expected value of output, the own-product cost of capital, and the elasticity of substitution in the productive process.[5] The usefulness of this model lies in the derivation of a long-run equilibrium relationship that lends itself to cointegration analysis. A representation is as follows:

$$K^* = A\, Y^e\, (1+ 1/\varepsilon)^{\sigma} / C^{\sigma} \qquad \text{(VII.1)}$$

K^* is the optimal level of capital stock; Y^e is the expected level of income; ε is the elasticity of demand in the product market; σ is the elasticity of substitution in production; and C is the cost of capital.

Net investment is then related to a distributed lag on changes in the optimal level of capital stock; replacement investment is usually taken to be proportional to the level of actual capital stock:

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[4]Since the First Plan was little more than an *ad hoc* collection of projects, this statement is meant to apply to all Plans since. While Plans can only provide estimates of private sector outlays, the change in emphasis to private sector investment, estimates of which which were larger than those for public investment in a corresponding period for the first time in the Seventh Five Year Plan, is instructive. See Approach Paper to the Seventh Five-Year Plan.

[5]This model is also the starting point for Shafik (1992).

$$I_t = \delta K_{t-1} + a(L)\,\Delta K^*_t \qquad \text{(VII.2)}$$

This can be viewed as a 'putty-putty' model, and the case with no substitutability ($\sigma = 0$), gives us the 'clay-clay' model or the flexible accelerator form. If the lag structures on output and cost of capital are not laid down *a priori*, a 'putty-clay' interpretation becomes acceptable. To get around the need to measure the level of capital stock, it is usually assumed that the steady-state rate of growth, g, is small relative to the rate of replacement of capital, δ. In a steady state:

$$\ln(K_t/Y_t) = \ln(I_t/[(\sigma+g)Y_t]) \approx \ln(I_t/Y_t) - \ln\sigma - g/\delta \qquad \text{(VII.3)}$$

This yields a long-run relationship of the form:

$$(i - y)^* = a - \sigma c - g/\delta \qquad \text{(VII.4)}$$

Short-run dynamics can be introduced through the use of a feedback or error correction mechanism, and the lags on output can be determined empirically.[6]

$$\Delta j i_t = \mu_1 + Q(L)\Delta_j y_t + P(L)\Delta_j c_t + \mu_4 c_{t-j} + \mu_5(i - (L^n)\,y)_{t-j} + \varepsilon_t \qquad \text{(VII.5)}$$

The use of $(L^n)\,y$ in the equation above attempts to capture the gestation lag between investment orders (based on y) and actual investment.

The underlying assumptions required to sustain the theoretical development yielding such a functional form are quite stringent. Yet, the usefulness of such a device derives from the long run relationship it establishes. Introducing modifications that are suggested by the particular

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[6]The use of an EC term or a similar control mechanism has become so widespread and well accepted that the justification for it does not appear necessary here.

features of the economy or sector being modelled, and following a data-based reduction to a congruent specification in the tradition of general to specific modelling could then provide a satisfactory description of the dynamics of investment. The choice of measures of investment, income, cost of capital and the specifics of the lag structure are best determined empirically rather than theoretically. The treatment of supply limitations and credit constraints is particularly important as the above analysis assumes that the desired levels of capital stock and investment can actually be implemented and achieved in practice. For instance, it is implicitly assumed that domestic non-availability of investment goods will pose no serious problem and foreign suppliers will cater to the needs of investing agents.

Issues to consider in the Indian case:

i. The examination of the relation between public and private investment has not been done in any systematic fashion for the period of the 1980s. The exploration of 'crowding out'/complementarity between public and private investment is of significance not only from the limited objectives of this dissertation, but the overall development process in India.[7] Exploration of this issue requires some care in identifying the direction of causation, even if the precise mechanisms of interaction may be difficult to identify.

It has frequently been argued that public and private investment are complementary rather than competitive in India. This view, contrary to that which assumes a 'crowding out' of private investment by public

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[7]See Sundararajan and Thakur (1980), Krishnamurthy (1985), Pradhan, et al (1990), and Chandrashekhar and Sen (1991).

capital formation, is based on an approach that considers that there are very important connections between private and public investment which makes them complementary rather than competitive.

ii. The relevance of increased private savings, the emergence of the stock market as a means of raising capital and the importance of profits - or private corporate saving - needs to be evaluated in accounting for increased investment.

Financing of investment through an expansion in commercial bank and development bank credit assumes importance in a system of credit allocation that is not based on the market, and where the quantum rather than the price of credit assumes importance. The importance of financing by the development banks continues to be great even following the emergence of a securities market; the backing of the large public financial institutions is an important determinant of share values in a market in which a large volume of trade is dominated by these development banks and financial intermediaries.

iii. The importance or otherwise of interest rates (a measure of the cost of capital) in the determination of investment requires investigation.[8]

The relative stability of the officially determined base rate and the structure of various borrowing and lending rates over a period of much change in inflation and rates of change of output reinforces the view that

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[8]It has been suggested by many that the rate of interest is only of marginal significance; as for so many other things in India, it is not the price as much as the availability that is of importance. Further, the real rates of interest were set extremely low, and information on non-institutional rates of finance are extremely difficult to obtain, given the specificity of the risk premia charged.

the availability rather than the cost of capital was the operative limitation or binding constraint on investment. In the 1980s, though, it is quite possible that the cost of borrowing was in and of itself a constraint to higher levels of investment in fixed capacity.

However, a more direct measure of the cost of investment, the price of capital goods, could play a more significant role than the price of finance in determining the level of fixed capital formation.[9]

iv. Access to, and availability of, imports as a determinant of investment activity is of special importance given that the bulk of imports are of intermediates.[10]

While it is customary to view imports as competing with domestic production, there seems to be a clear distinction between the perceived role and function of indigenous and imported technology and the producer goods they are embodied in. In several cases, the importance of imports lies not in their relative quantum as much as the key position they may occupy in a particular production process or technology. Hence there is reason to expect a positive relation between imports of capital

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[9]Lucas (1989) suggests that in India, the price of capital goods is an important determinant of investment in the industrial sector.

Jorgenson (1963) shows, for perfect competition and with no taxes:

$$c = [a(r + \delta) - E\dot{a}]/a$$

where a = price of capital goods, r = rate of interest, δ = rate of depreciation, E = exponential operator. Much earlier, Keynes (1936) had emphasized the importance of the supply price of capital in determining investment.

[10]The result linking investment to the level of imports reported by Chandrashekhar and Sen (1991) will be critically examined in an encompassing framework.

goods and levels of investment. Of course, in the long term, the viability of the domestic capital goods sector may be severely influenced by policy with regard to technology and investment.[11] It has been suggested that, in contrast to the scenario most often considered of a destruction of existing, and throttling of potential, domestic technological capacity by foreign purveyors of technology, the Indian case has been one in which domestic producers, more or less taking protection for granted, have made no effort to develop technology domestically, instead relying on low-level and second-rate technology that is obsolete abroad.[12]

The fact that foreign investment in India has been associated with access to foreign exchange and concomitant technology that is perceived to be 'better', is further likely to reinforce such a positive connection between investment and imports of capital goods. With foreign collaboration comes capital, investment goods and technology that may otherwise not have existed in the form of an indigenous counterpart or alternative.

Influences on private investment in India: an illustrative model

The model due to Chandrashekhar and Sen (1991), which is illuminating by accident rather than design, provides a good starting point for a discussion of the empirics of private investment. The model provides an interesting example of what has been termed "spurious regression".[13] The conclusion of complementarity between private investment and public

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[11]That is, so long as there is such a thing as a 'policy'.

[12]Desai (1984).

[13]See Granger and Newbold (1974) and Hendry (1986). There is no distinction between nonsense regressions (integrated but mutually independent time series) and spurious regressions.

investment arrived at in this study is largely a consequence of inadequate attention to the time series characteristics of the model variables and a neglect of diagnostic testing of the econometric specification.

Chandrashekhar and Sen (1991), in their discussion of alternative "adjustment" scenarios, report the following equation for 1970-89:

$$RCFI = a_2 + b_2RGFI + c_2RMKG \qquad \text{(VII.6)}$$

$a_2 = -1292.7$; $b_2 = 0.22$; $c_2 = 1.36$; $R^2 = 0.92$; DW stat. = 1.36

where RCFI = real corporate fixed investment; RGFI = real government fixed investment; RMKG = real imports of capital goods.[14]

While this specification can be criticised on several different grounds, it suggests the possibility of re-estimation of the relationship between private and public fixed capital formation, with a significant role for the imports of capital goods. The value of the DW is low and suggests that the residuals are autocorrelated; it also suggests that the variables are cointegrated, and it would be useful in and of itself to investigate this more closely.[15] The very large coefficient on RMKG could be interpreted as an indicator of the importance of access to imported investment goods; equally it could be an outcome of misspecification - RMKG and RCFI have very substantial areas of overlap - and weak exogeneity necessary for valid conditioning may not be satisfied. As no diagnostic tests or even standard

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[14]Chandrashekhar and Sen (1991) pp. 658.

[15]The DW for variables in levels is the CRDW for testing the null of non-cointegration. The relevant critical value is 0.358. In the Engle and Granger (1987) two-step procedure, the first step in estimating a cointegrating vector is to perform OLS regression in levels of the variables under consideration.

errors, for that matter, have been reported, any discussion of the nature of the connections is necessarily speculative.

I re-estimated this equation to allow diagnostic and mis-specification testing and obtained:

$$RCFI = -1896.97 + 0.43\,RGFI + 0.24\,RMKG \qquad \text{(VII.7)}$$
$$[780.68] \quad [0.17] \quad [0.71] \quad \text{[Standard error]}$$

(OlS estimates 1970-1 to 1988-9) Adjusted $R^2 = 0.096$; $R^2 = 0.86$; $\sigma = 906.65$; D.W. = 0.88

Normality $\chi^2 = 1.06$; Serial correlation $\chi^2\,(2) = 7.27$

AR 1-2 F (2, 14) = 4.34; ARCH 2F (2, 12) = 0.44.

The parameters obtained are somewhat different from those estimated by Chandrashekhar and Sen (1991), and that is likely to have been a result of different measures of the variables. The broad conclusion that the equation is misspecified, and is an example of "spurious regression" is sustainable given the very limited explanatory power of the equation, and the clear evidence of residual autocorrelation. Public and private capital formation have both been growing over time, and hence are likely to reveal positive correlation when measured in levels, though the picture is quite different when the variables are differenced.[16]

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[16]The equation above was also estimated using logs of the variables. There was little change in the diagnostics, and the conclusions that have to be drawn from them.

$$rcfi = -2.30 + 0.32\,rgfi + 0.98\,rmkg$$
$$[2.73] \quad [0.74] \quad [0.60] \quad \text{[Standard error]}$$

(OLS estimates 1970-1 to 1988-9) Adjusted $R^2 = 0.007$; $R^2 = 0.81$; $\sigma = 28.52\%$; DW = 1.01

Given some of the results we have presented above, it should come as no surprise that this equation is seriously mis-specified, and does not warrant the kinds of conclusions that Chandrashekhar and Sen draw from it. If anything, public and private investment are negatively related, and there is evidence for the operation of a 'crowding out' phenomenon in the case of gross fixed investment as well as in the context of capital formation in machinery and equipment.

The relation between public and private investment

The issue of the complementarity of public and private investment brought into focus by the study of Chandrashekhar and Sen (1991) is considered in some detail here and evaluated against the alternative of a 'crowding out' of one kind of investment by the other. This exploration has direct bearing on the demand for capital goods, and hence for industrial output. In addition, the capacity creation aspect of investment lends significance to the nature of the capital formation process, particularly because of the limited contribution of the 'growth accounting residual', or factor productivity growth, to output increases.[17]

Pradhan, et al (1990) provide a useful definition of 'complementarity' and 'crowding out' in the context of public and private investment to set the stage for this discussion. 'Crowding out' is defined by them as occuring

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Normality $\chi^2 = 0.95$; Serial correlation $\chi^2(2) = 4.89$; AR 1-2 F (2, 14) = 2.42; ARCH 2F (2, 12) = 0.10.

[17]Even the most generous estimates of this productivity growth are quite small and very insignificant when compared with the experience of virtually any economy that has industrialised to any substantial extent. See Krishna (1987) and Ahluwalia (1991) for details on estimates of TFP growth. The issue is considered briefly below.

when private investment decreases as a result of an increase in public investment, and 'complementarity' exists when an initial increase in public investment leads to an increase in the total investment in the economy.[18] This allows the possibility of the coexistence of the two phenomena which they attempt to isolate by the use of a CGE model in the tradition of Shoven and Whalley (1984).

In any growing economy, it would be natural to expect both private and public investment to be growing, certainly in nominal terms, and in real terms as well. The consequent increase in real investment would then meet the definition of complementarity, so long as any increase in public investment was not accompanied by a decline in private investment of a greater magnitude. It would seem reasonable to argue that complementarity is a fairly common phenomenon, and certainly one that has been observed in India.

Perhaps it would be more useful to consider the two effects in different time frames - it seems as if there is a long-run complementarity between capital formation in the public sector and private investment, and a short-run 'crowding out' effect. The evidence suggests that this is a phenomenon that is typical of developing countries generally, as Blejer and Khan (1984) demonstrate in their study of 24 countries for the period 1970-79.[19]

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[18]Pradhan, et al (1990) p. 102. Similar notions of complementarity and crowding out characterise the work of Sundararajan and Thakur (1980) and Blejer and Khan (1984).

[19]The study by Sundararajan and Thakur (1980) also points crowding out in the short-run and complementarity in the long-run, in the case of both India and Korea. The extent of the crowding out in the two case, however, is quite different, and possible reasons for this are considered below.

If the definitions of 'crowding out' and complementarity proposed by Pradhan, et al (1990) are accepted, there is quite obviously a coexistence of the two phenomena in India in purely statistical terms, even though it is impossible to isolate the two modes of interaction outside of a detailed structural model.[20] To argue that the increase in private investment is purely an outcome of an increase in public investment obfuscates the opposite movements in these variables in difference terms. In identifying a demand function for machinery and equipment for the private sector, I find that there is not a stable relationship with public fixed capital formation in terms of equipment. The fact that private demand for machinery and equipment can be modelled adequately without including government investment terms in levels, suggests that the case for complementarity has been overstated. The clear divergence, virtually year to year, between the direction of change in private investment and that in public investment suggests that it is more reasonable to talk in terms of 'crowding out' than complementarity.

Perhaps the key to this puzzle lies in the time-series characteristics of the series being modelled. The investment series in levels terms are likely to be I (1), and the differenced series, by implication, are I (0), and correlation between the series in levels could be high, even though there is a negative impact effect of changes in public investment on private fixed capital formation. In a growing economy, the two series are likely to behave similarly, and the correlation may be an outcome purely of the order of

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[20]Blejer and Khan (1984) suggest that a classification of public investment into what was "expected" and of an "infrastructural" nature would enable a better distinction between crowding out and complementarity, since expected investment would be incorporated into investors decision-making, and infrastructural investment was likely to make private investment more productive.

integration of the series, and the seemingly large positive influence in terms of a high correlation coefficient may, consequently, be spurious.[21] This interpretation seems to be supported by Sundararajan and Thakur (1980) who find a significantly negative partial correlation coefficient between public and private investment, allowing for a time trend.

I will proceed by examining the relation between public and private fixed capital formation, first by considering the constituent parts of machinery and equipment, and construction respectively, and then aggregate fixed capital formation. By doing so, I hope to isolate the direction of Granger-causation, which also serves to underpin my attempt at modelling private demand for machinery and equipment. This model of private demand for investment goods treats public fixed capital formation in the form of machinery and equipment as exogenous.

As the discussion above reveals, it is quite clear that public and private capital formation appear to be positively correlated when considered in levels, and this is a consequence of the fact that they involve variables that are increasing over time. To avoid the problems created by the non-stationarity of these series, and not arrive at "spurious regression", I consider these variables in differenced form.[22]

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[21]Recall the Granger and Newbold (1974) intervention on 'nonsense' or 'spurious' regressions.

The econometric specification in Pradhan, et al (1990) for private investment demand to public investment does not seem to be particularly well specified. The D.W. statistic, which is the only diagnostic test reported, has the low value of 1.12. (p. 116).

[22]Engle and Granger (1987) provide several examples of such regressions involving non-stationary series. Differencing not only renders the I(1) series stationary, it helps

The investigation essentially consists of displaying the public and private aggregates for the different categories of investment visually, and checking the pairs of series for Granger-Causality. The tests for Granger-Causality also reveal the negative relation between public and private capital formation for all three of the categories, and clear the way for the inclusion of public fixed capital formation in plant and equipment in a model of private investment in plant and equipment.[23] Later, private machinery demand is modelled employing the insights gained from this investigation. The phenomenon of 'crowding out' is clearly revealed in the estimated model.

Testing for Granger-Causality is done using a finite autoregressive distributed lag model using one lag for both the autoregression and the distributed lag. The F-statistic under the null of no Granger-Causality is reported, along with the probability under the null.[24]

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reveal the diametrically opposite patterns of change that characterise fixed capital formation in the private and public domains visually, literally at a glance.

There is a certain loss of information through such a reparametrisation by differencing, but there does not seem to be any variable that is cointegrated with pvtme.

[23]Clearly, Granger-causality is different from weak exogeneity, which is all that is necessary to meaningfully condition on contemporaneous variables. Engle, Hendry and Richard (1983) stress this point in their discussion of exogeneity.

[24]See Doornik and Hendry (1992) pp.28 for a description of this test. The associated probability is reported in [brackets].

Machinery and equipment

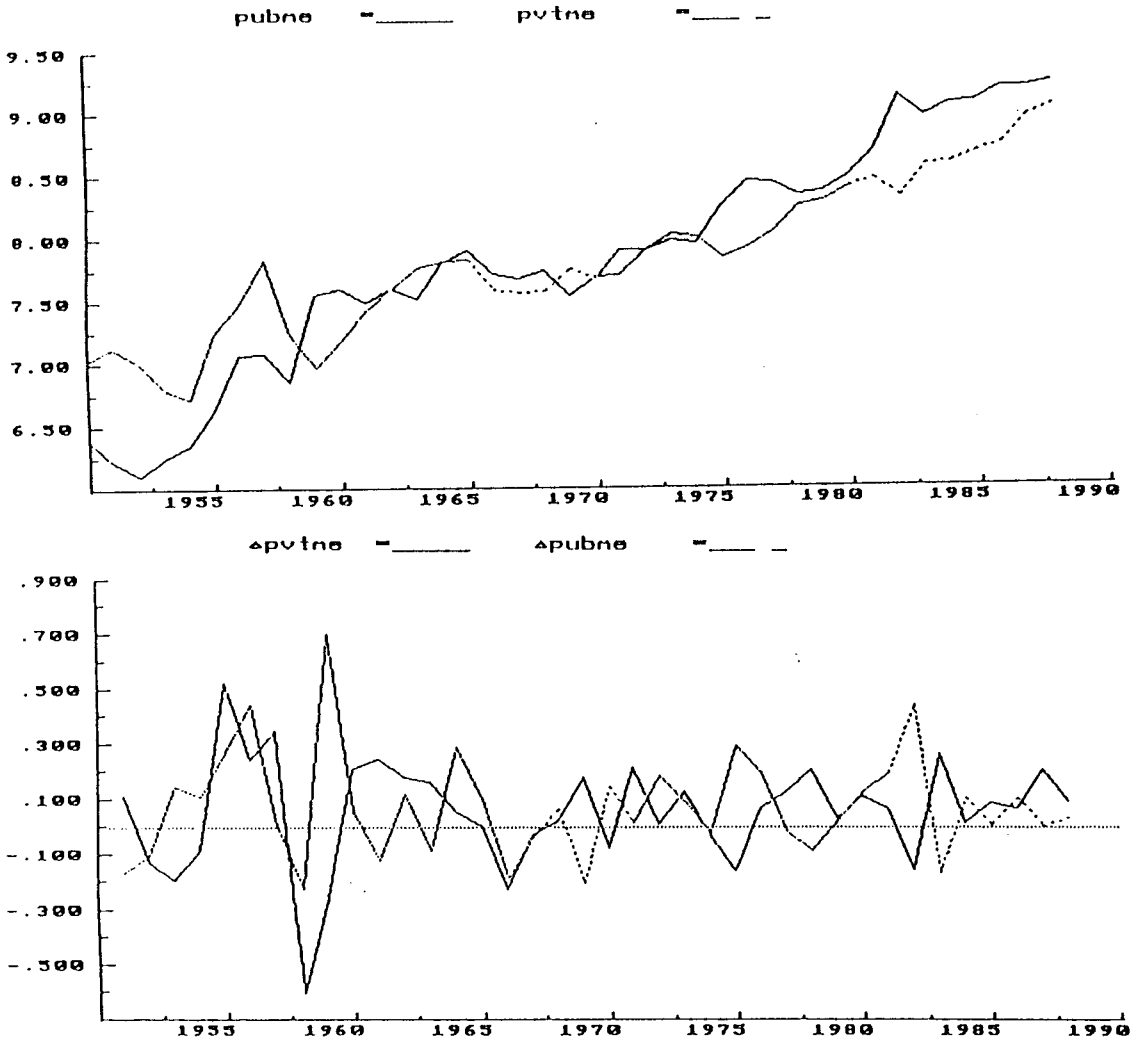

Figure VII.i: Changes in equipment investment, public and private - measured in logs. Levels (upper) and first differences (lower). Source: NAS.

Granger-Causality tests: (Sample size = 37)

For adding Δpubme to Δpvtme: F (2, 33) = 3.96 [0.029].

For adding Δpvtme to Δpubme: F (2, 33) = 1.13 [0.336].

The causality in Granger terms runs from public investment in machinery and equipment to private capital formation, and not the other way.

One potential reading is that there is really a lag between public investment in machinery and its impact on private investment in the same area. However, there seems to be a year to year oscillation from positive to negative in both series when considered in difference terms, and the amplitude of the movement seems to be roughly of the same order of magnitude in opposite directions in the same period. In the event, it seems difficult to support any other view than one that looks at the two categories as competing rather than complementary.

Construction

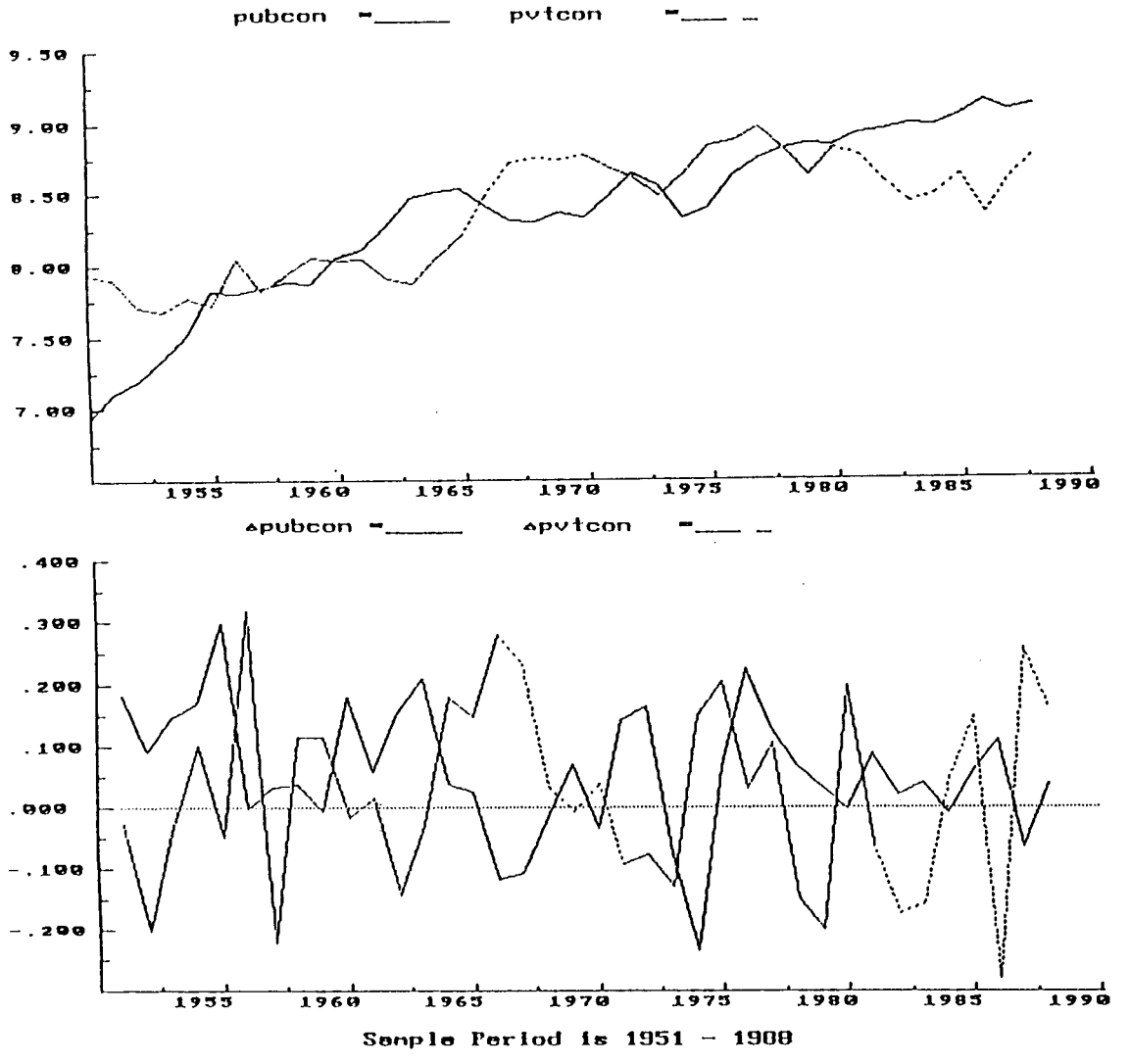

Figure VII.ii: Capital formation in the form of construction, public and private - measured in logs. Levels (upper) and first differences (lower). Source: NAS.

Granger-Causality tests: (Sample size = 37)

For adding Δpubcon to Δpvtcon: F (2, 33) = 3.12 [0.057].

For adding Δpvtcon to Δpubcon: F (2, 33) = 3.80 [0.033].

In this case, the influence appears to run in the converse fashion to that in the case of machinery and investment, but the null of non-causality from public to private is sustained by an insubstantial margin.

Aggregate fixed capital formation

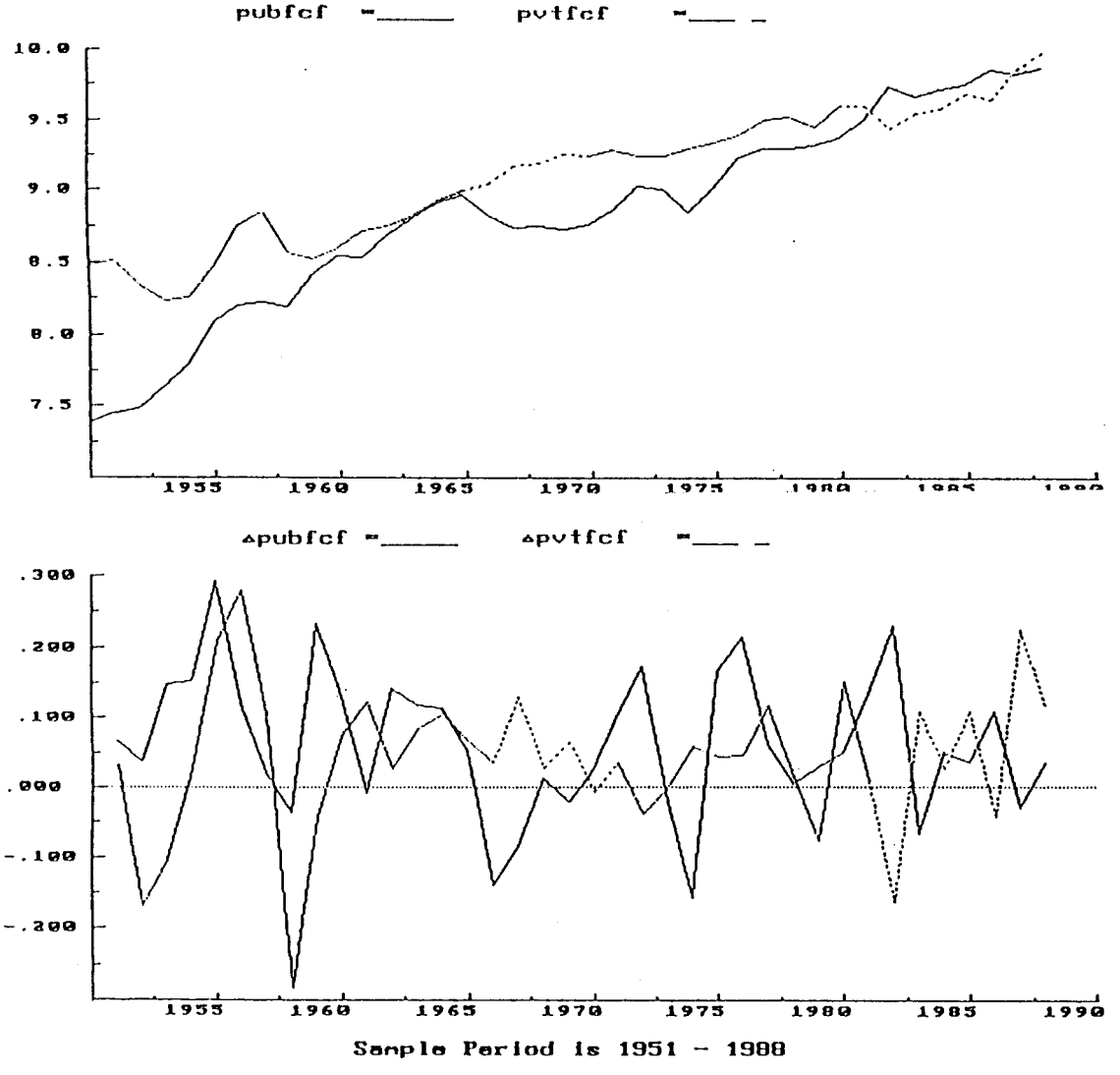

Figure VII.iii: Aggregate fixed capital formation in the form of construction, public and private - measured in logs. Levels (upper) and first differences (lower). Source: NAS.

Granger-Causality tests: (Sample size = 37)

For adding Δpubfcf to Δpvtfcf: F (2, 33) = 1.70 [0.199].

For adding Δpvtfcf to Δpubfcf: F (2, 33) = 0.48 [0.624].

The aggregation of the components of fixed capital formation masks the nature of causality, and the null of non-causality is the maintained hypothesis. As the accompanying graphs reveal, there seems to be almost a year to year matching in terms of the opposite direction of movement of the public and private components of fixed capital formation, but this is less pronounced when the aggregates are compared.

A speculative word about the public-private relation

Explanation of the 'crowding out' of private demand for machinery and equipment by public sector demand is of less relevance to this dissertation than the fact of 'crowding out' itself. However, a set of explanations is briefly considered here.[25]

Government expenditure has never really been viewed as playing a countercyclical role, either by those outside of government or by those in it. Fiscal policy has been tailored to avoid inflation, or at least to avoid adding to the inflationary pressures that have been a characteristic of the evoluting Indian economy in the 1980s.[26] Furthermore, public investment has usually been undertaken with a view to create and add to productive capacity in the public sector. In such a context, it should not be surprising to learn that the direction of causality runs from public investment to private fixed capital formation.

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[25]For a more detailed discussion, see Sundararajan and Thakur (1980), Blejer and Khan (1984) and Pradhan, et al (1990).

[26]A look at any of the Budget Speeches by Finance Ministers in the 1980s, as well as the VII Five Year Plan documents would reveal the extent of the stated desire to overcome inflationary pressures.

It has always been taken for granted that major infrastructural investment would be undertaken by the state in virtually every developing country. In India, this role was a particularly significant aim of public investment, as successive Five-Year Plans reveal. Such investment could be expected to raise output and productive capacity to varying degrees, and, regardless of its efficiency, raise demand for private sector output.[27] To the extent that state investment took place in areas that would have required private investment, it could be viewed as having reduced the need for private investment.

The 'crowding out' mechanism can work in two ways:

i. the limited capacity of capital goods production and the system of licensing and non-market allocation, and the limited amount of imports possible, with a first claim by the state on the constrained supply of these resources would leave only the residual for private investment. Not only did the public sector compete with the private sector for physical and financial resources, but the government sector was able to exercise prior claim on these scarce resources.[28]

ii. Equally, the operation of 'crowding out' effects that work through the price of machinery (in the absence of the conventional 'crowding out' effects that are supposed to operate through the interaction of interest

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[27]Tun Wai and Wong (1982) evaluate the importance of the links between government investment and private investment for five developing countries. They find public investment to be the most important influence in three of the countries, and they emphasize the multiplier and infrastructural impact of this investment.

[28]Sundararajan and Thakur (1980) also emphasize the importance of non-price mechanisms in crowding out.

rates) could make the amount of private investment dependent on the level of public investment. As demonstrated below, the price of capital goods is an important influence on the demand of the private sector for investment goods.

Ultimately, there is no *a priori* reason to expect the net effect of 'crowding out' and complementarity to be positive or negative. The specific conditions in which investment is undertaken, the perceived role and stated objective of state expenditure and the relation between the state and business all play a role in the outcome of this interaction. In contrasting the Korean experience of a net complementarity with that of 'crowding out' in India, Sundararajan and Thakur (1980) suggest that the immediate 'crowding out' effect was stronger in India as resource availability had a greater influence on the speed of adjustment of capital stock, partly because of the much lower rate of depreciation.[29] The nature of the linkages between public investment and the rest of the economy are likely to be an important influence too - public investment in India was typically concentrated in sectors with forward linkages, while in Korea it involved backward linkages too.[30] Not surprisingly, the multiplier effects of increased public investment in India are weak.

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[29]Sundararajan and Thakur (1980) point out that the rate of depreciation in Korea was 10% compared to 4% in India.

[30]See Sundararajan and Thakur (1980). Public investment in India tended to be concentrated in areas such as steel, cement, fertiliser, and other producer goods areas. In another context, this fact of state production of vital inputs has been blamed for the high cost structure of Indian industry. See Chandra (1984).

A suggestion for an economy-wide machinery and equipment investment demand function

As I am concerned with the demand for industrial output, it becomes necessary to look at the component of investment that is catered for by industry, and this requires the use of an appropriate aggregate for modelling.[31]

$$I_{pvt\,d} = i\,(I_{pub}, S_{pvt}, \Delta Credit, r, M_K, Y) \qquad \text{(VII.8)}$$

($I_{pvt\,d}$ = private investment demand; I_{pub} = public investment; S_{pvt} = private saving; r = interest rate; M_K = imports of capital goods; Y = aggregate income)

Any apparent similarities with specifications for investment in the manufacturing sector are misleading - what is sought is a model that relates demand for investment goods produced by the industrial sector, namely machinery and equipment, to various determinants that are economy-wide variables. For instance, the income variable of relevance in the function above is an economy-wide aggregate rather than the output of the industrial sector if an accelerator-type phenomenon is an important determinant of the level of investment.[32]

An additional reason why the Q theory is unlikely to offer much insight into capital formation of this type is the limited relevance of the

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[31]Recall here the intervention by Ramana (1984) which focused on the differential impact of private and public investment owing to the different composition in terms of machinery and equipment and construction.

[32]Jorgensen type flexible accelerator investment functions have been quite widely used to investigate investment in developing countries. See Blejer and Khan (1984) for instance.

conventional measure of the cost of capital - the interest rate - in making investment decisions.[33] As many have pointed out in the Indian context, the availability of credit, rather than its cost, is the issue - credit is cheap for those who can gain access to it.[34] The relative fixity of the nominal interest rate, and the various distinct categories under which preferential and concessional credit can be obtained lend further support to an analysis that gives greater importance to the quantum of credit rather than its cost.[35]

I obtain a specification for private investment in machinery and equipment for the period from 1958-9 to 1988-9, being constrained by the period for which data on machinery imports are available.[36] The general model includes the change in GDP (to capture accelerator-type affects) and the change in credit disbursed by commercial banks (to test for the influence of the quantum of credit on investment).

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[33]Sensenbrenner (1991) assesses the advantages of the Q model of Tobin and Brainard (1977) over the Jorgenson neoclassical approach in the context of six OECD countries, providing a recent perspective on the Q model. Precious (1987) develops the Q theory in a non-market cleearing context.

[34]This observation can be traced to McKinnon (1973). While these interventions have usually been made with reference to the agricultural sector, the general point retains validity for the industrial sector as well as for exporting agencies.

[35]Even if cost of credit were an important determinant of investment decisions, the multiplicity of rates would come in the way of using a single "representative"interest rate. The picture is made further indistinct by the operation of the informal credit markets, about which information is difficult to come by. Gupta (1983) provides a good discussion of informal credit markets, and the nature of the agents and instruments that characterise it.

[36]These data are available from 1956-7 onwards, but the inclusion of the differenced variable lagged one period further reduces the data span.

Table VII.1: Integration statistics

Variable	D.W.	D.F.	A.D.F.
pvtme	0.1249	-0.3624	-0.5382
pubme	0.0609	-1.129	-1.04
mme	0.1441	-0.7381	-0.5382
corps	0.1001	-0.7098	-0.4932
pme	0.0202	-3.435	-3.447
cred	0.0144	6.332	3.648

1952-53 to 1988-89, 37 observations for all variables except mme with 30 observations from 1959-60 to 1988-89. D.W. = Durbin-Watson test statistic, D.F. = Dickey-Fuller test statistic, A.D.F. = Augmented Dickey Fuller test statistic. For variables that incorporated a time trend, the test statistics were evaluated including a trend. Evaluated using PC-GIVE 7.0. * indicates significance at the 5% level, and ** at the 1% level.

The hypothesis of a unit root is accepted for all the variables above. The DF and ADF test statistics for the price of machinery and equipment, though high, still lie within the 5% significance limit.

The Johansen procedure failed to reveal the existence of cointegrating vectors involving private equipment investment, public equipment investment, corporate saving, and changes in credit allocation.[37] The

[37]This is not entirely surprising in the light of the discussion above concerning the relationship between public and private components of capital formation.

most likely candidate for a long-run equilibrium relationship would be corporate saving, but the process of investment is greatly influenced by the availability of finance from sources external to the firm, and this perhaps precludes the existence of any link that is reasonably robust in the long-run.[38] Hence, a general model was estimated for changes in private fixed capital formation in machinery and equipment, thereby modelling the demand for investment goods produced in the manufacturing sector.

The process of reduction yields a parsimonious model-specification of the following type:

$$\Delta pvtme_t = \beta_0 + \beta_1 \Delta pubme_t + \beta_2 \Delta corps_t + \beta_3 \Delta pme_t + \beta_4 \Delta mme_{t-1} + \beta_5 pvtme_{t-1} + \beta_6 corps_{t-1} + \nu_t \qquad \text{(VII.9)}$$

Table VII.2: Private investment demand for industrial output

Variable	β_0	β_1	β_2	β_3	β_4	β_5	β_6
Coefficient	-1.008	-0.349	0.355	-1.073	0.149	-0.361	0.564
t-value	-2.75	-4.42	3.76	-5.61	1.72	-4.74	4.94

D.W. = 2.43; Adjusted R^2 = 0.94; σ = 5.71%. (RLS estimates for annual data 1959-60 to 1988-9 less 3 forecasts.)

Chow F (3, 20) = 0.40; Normality χ^2 = 0.22; AR 1-2 F (2, 18) = 1.35; ARCH 1F (1, 26) = 0.98; Forecast χ^2 (3)/3 = 0.50.

[38]In recent years, the stock market has provided an increasingly important source of finance, and a large number of the largest firms in India have emerged by tapping the growing capital market. In the second half of the 1980s in particular, public issues were frequently oversubscribed to the extent of 500%, allowing the emergence of what Hilferding (1910) first termed "promoter's profit".

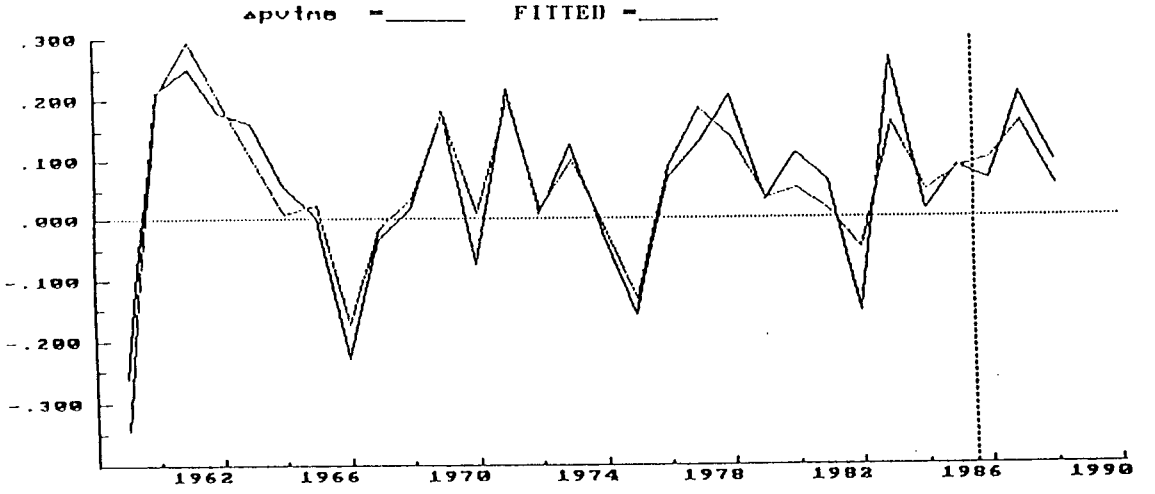

Figure VII.iv: Modelling private equipment investment - Actual and fitted values.

The t-values for the 1-step forecasts are :

(Date)	1986-7	1987-8	1988-9
(t-value)	-0.55	0.67	0.55

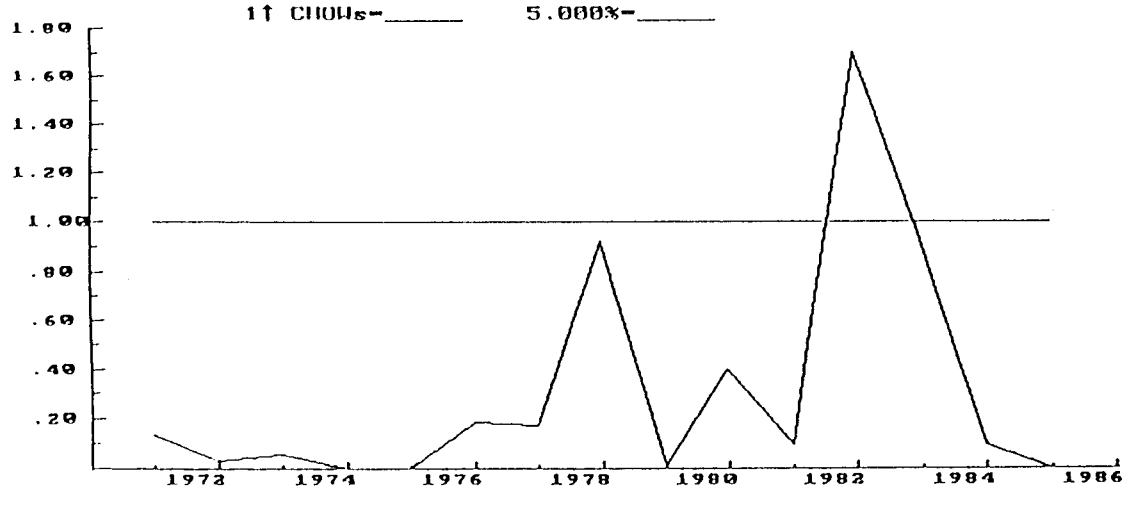

Figure VII.v: Model of $\Delta pvtme_t$ - Sequence of one-step ahead Chow tests.

While the out-of-sample forecasting performance is very good, there is predictive failure within sample in terms of the one-step-ahead Chow test

for 1982-3. At the same time, it is important to note that the other tests of parameter constancy, including the size of the one-step ahead residuals and the forecast Chow tests support the hypothesis of parameter constancy. The battery of mis-specification tests are passed with considerable leeway, suggesting that the model is congruent.

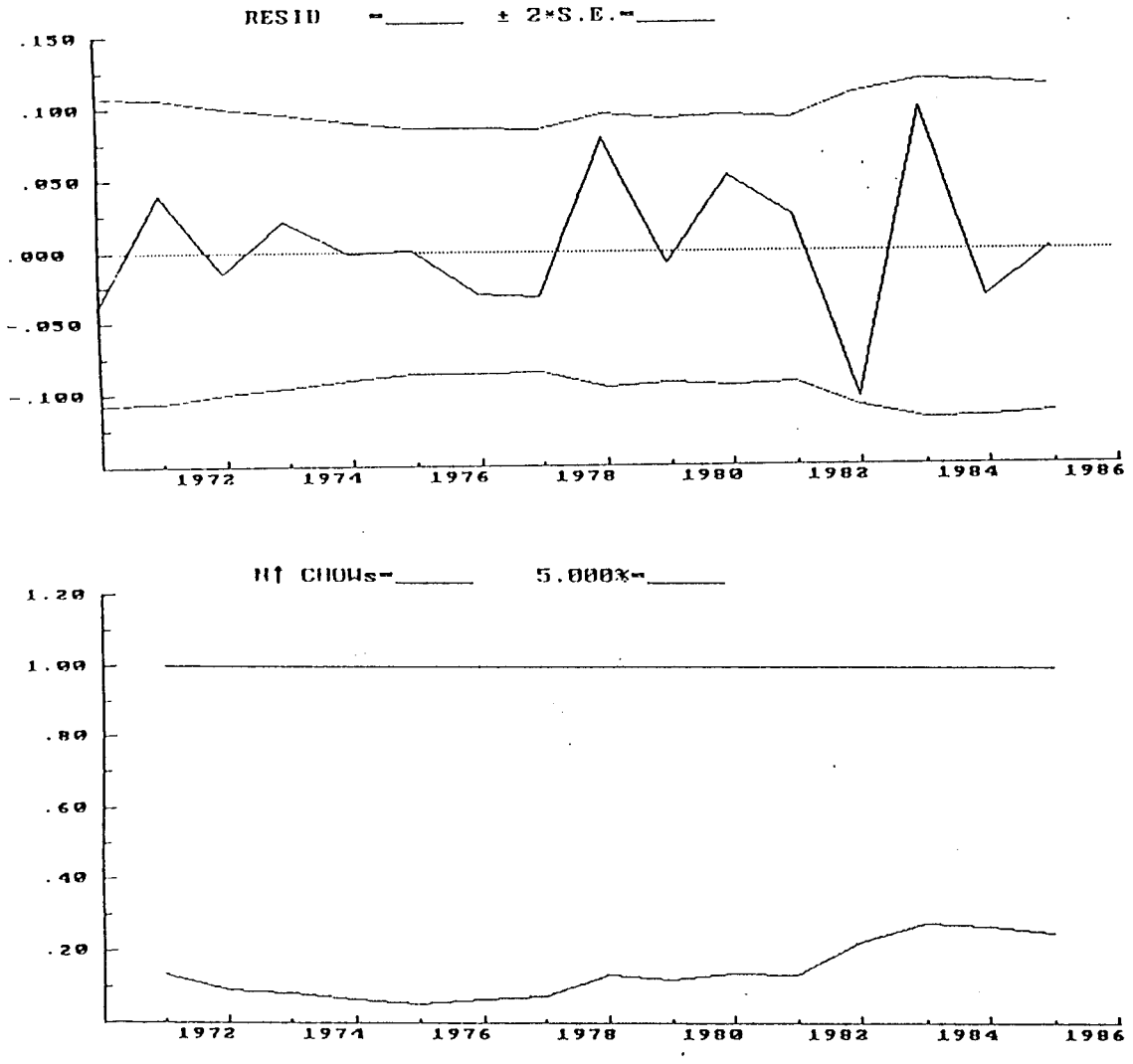

Figure VII.vi: Sequences of one-step residuals (upper) and forecast Chow tests (lower).

The estimated signs of the coefficients are very much in line with intuitive expectations, and the t- values suggest that the coefficients are well determined. The coefficient on the lagged change in imports of

machinery and equipment is the only term that is not obviously well-determined, but its exclusion from the model leads to a substantial deterioration in the predictive and explanatory power of the model.

The qualitative significance of capital goods imports is perhaps greater than their cumulative quantitative impact, as borne out by the great contraction of investment with the imposition of very stringent import controls in 1991. Imported capital goods often are vital components necessary for production, and these components could well be of such a nature that they are a relatively small proportion of equipment in terms of value and yet not be replaceable by domestic inputs. The analogy of a vital trace element or vitamin in physiology, or a catalyst in chemical processes captures the role that such imported capital goods may play. The increased imports of capital goods in the 1980s could well have played such a role in enabling higher levels of capital formation in the private sector, a significance that would not be captured by the magnitude of such imports.

The insignificance of the interest rate in influencing private capital formation is not entirely unsurprising. For developing countries, the interest rate has been an inaccurate indicator of the cost of capital, and unlikely for that reason alone to be an important influence on investment. Possibly, the rationing of credit and the operation of licensing combined to limit any possible impact which the interest rate might have had on investment decisions. It has been suggested that the interest rate could affect investment through its impact on levels of saving. A higher interest rate could increase levels of saving, and relax the constraint on

investment set by the availability of savings.[39] The interest rate has no quantifiable impact on investment while the price of machinery and equipment has a significant role in determining trends in capital formation.

The price of machinery has been suggested as being a better measure of the cost of investment in India than the interest rate.[40] Evidence from developed countries for the period 1960-85 suggests that the price of machinery is an important determinant of the rate of machinery investment, and the equation above demonstrates that it is a significant influence in India too.[41] The role of the price of capital goods is perhaps best understood in terms of its impact on the magnitude of investment that can be carried out once the investment decision has been taken and the requisite permission obtained.

Apart from the cost of credit, the quantity of credit does not seem to have played a role in the determination of private investment. The non-significance of the credit term is a little puzzling, but bank credit is only one form of credit available to investors. The growth of new modes of financing in the 1980s may be relevant in accounting for the limited

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[39]See Blejer and Khan (1984) for such a view. It is not clear that an increase in the interest rate should lead to an increase in saving in general, and the evidence for India suggests that there is no such influence.

Sundararajan and Thakur (1980) suggest that the savings constraint may be important when there is a repression of financial mechanisms, a line of reasoning counter to the Keynesian view of the relation between saving and investment.

[40]See Lucas (1989).

[41]See Summers (1990) and DeLong and Summers (1991).

importance of this term. The massive growth of the securities market in the 1980s provided an entirely new avenue of financing. The importance of the stock market is difficult to quantify because of the great increase in the share price index and the difficulties in obtaining consistent figures on new issues or accurate indicators of the volume of capital that was raised.[42] The change in the nature of the securities market in the 1980s is difficult to model in the absence of reliable figures, and this omission is one that needs to be addressed in the future.

At the same time, corporate sector saving is a significant variable, indicating, once again, the importance of internal financing, in contradistinction to the Miller-Modigliani (1958) type of result. In the context of developing countries where financing constraints operate to a far greater degree than in developed countries, such a result is not likely to be valid.

In terms of levels, there has been a sustained increase in levels of capital formation in both the private and public sectors. This secular increase in demand for machinery and equipment in the private sector could well have been induced by an increase in profits that were manifested in terms of increased corporate savings. Both the long-run elasticity and the impact effect of corporate saving are positive, and the values are well-determined.

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[42]The share price index published in the IMF International Financial Statistics moved as follows:

1965	1970	1975	1980	1985	1990
40.6	50.9	49.9	78.1	100	241.3

The role of public investment is best interpreted in light of these results. The fact that the rate of expansion of state investment was limited was critical in allowing private investment to grow - a somewhat perverse result given that the rationale for public investment was claimed to be its positive impact on overall growth. The nature of fiscal expansion and the direction of the increased fiscal activity appear to have been more important than the extent of the increase in government expenditure.

VIII

THE EXPORT SECTOR IN THE ERA OF LIBERALIZATION

The relationship between development and industrial growth and exports has been one of the most controversial and widely debated. The continuing success of export-oriented economies suggests that there is an unquestionable link between export dynamism and industrial and overall economic vibrancy.

From the point of view of this dissertation, the issue of importance is the answer to the question - is the growth of industrial exports a cause or consequence of the dynamism of the industrial sector as a whole, or are the two largely unrelated?[1] In India, an additional dimension to this connection has been suggested as being the significance of the 'push' of domestic factors rather than the 'pull' of higher export demand - enhanced industrial performance contributing to improved export growth.

The question that is of relevance to this dissertation is the importance of export demand and production to the performance of the industrial sector. This question is a little different from the usual motivation of studying export performance to identify the constraints on increasing foreign exchange earnings.

I will present a brief summary of the main arguments relating to Indian export performance since Independence and draw attention to some

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1Nayyar (1976) and the Hussain Committee Report (1984) argue that export production is typically the "end of" domestic production, and that enhanced domestic performance and efficiency is likely to translate itself into improved export performance.

salient features of the developments in the 1980s. Since the focus of this dissertation is on manufactured exports only, I concentrate on the main findings of studies of this subset of exports. The findings of these studies, and the difficulties in quantifying the various changes in the export promotion schemes provide a justification for treating demand from the rest of the world as exogenous for the purpose of this thesis. Also, the focus on the relationship between exports and domestic manufacturing activity justifies the use of export data specified in rupee rather than dollar terms inspite of the large fall in the value of the rupee in the 1980s.

Reasons for an emphasis on the export sector

The treatment of the manufacturing export demand in this chapter should not be taken to reflect a position that accords little importance to events in the external sector. On the contrary, any discussion of liberalization has necessarily to deal with developments in the external sector, not least because the external sector was a focal point of policy change. Liberalization of imports was meant to engender greater efficiency in production by exposing domestic producers to foreign competition besides offering an avenue of technological upgradation and access to imported inputs necessary to compete in world markets. In this way, liberalization was meant to promote greater efficiency at home, and provide a fillip to exports as well.

The Report of the Committee on Trade Policies in 1984 marks a major shift in the stated attitude to exports on part of the Government of India, even though there was a creeping, gradual evolution in the overall

orientation of policy from the late 1970s.[2] For the first time, export-promotion and import-substitution were not viewed as mutually exclusive sets of policies. The report also stressed the need to provide positive incentives to exporters, and not just to compensate them for the disadvantages inherent in producing in India for the purpose of exporting to the rest of the world. The policies of liberalization in the 1980s can be seen as being based on arguments adumbrated in this report; once again, it is instructive to note that this report was presented only in December 1984, by which time a recovery in industry was well under way.

The change in attitude to exports, as in case of liberalization generally, reflected trends in thinking and experience world wide, quite apart from questioning the Singer-Prebisch export pessimism thesis, which provided the theoretical underpinning for the strategy of import-substitution in the Mahalanobis Plan.[3] It is a recognition both of the incorrectness of the approach to exports in the earlier years and of the fact that external constraints in the first two decades of planning were not binding by any means.

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[2]Nayyar (1987) traces the beginning of trade liberalization to 1976-7, though "structural changes in import policy liberalised import replenishment facilities for the export sector and OGL provisions for the economy as a while" in 1978-9. (p. AN-90).

[3]See Bhagwati (1978) and Krueger (1978).

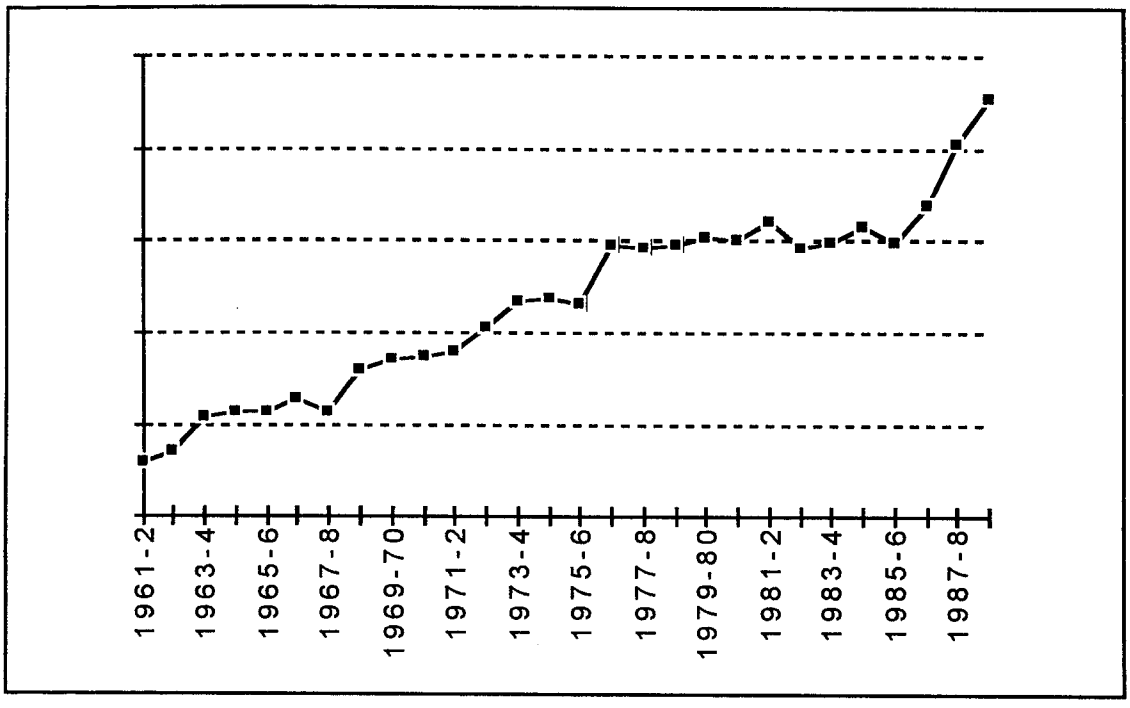

Figure VIII.i: Real non-oil manufacturing exports (semi-log scale). Source: Economic Survey, various issues.

The graph above represents movements in the value of manufactured exports in rupee terms deflated by an overall export price index.[4] Oil exports are excluded because of their phenomenal nature - these exports were of a large magnitude in the early 1980s, and involved a swap of crude oil produced in Bombay High for oil more suited to indigenous refining capacity. As would be expected, trends in this most important component of manufactured exports follow trends in all exports, with somewhat different peaks and troughs.[5]

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[4]The export price index (1985=100) has been taken from IMF International Financial Statistics. Ideally, a manufacturing export price index should have been used, but the coverage of available series of this type was shorter.

[5]Nayyar (1987) describes trends in all exports.

The most significant aspect of manufacturing export performance is the absence of the stagnation characteristic of industrial output since the mid-sixties. The fairly steady increase in the period from 1965-6 to 1976-7 was followed by a period of virtual stagnation until 1985-6. The steep increase in the last three years represented in the graph could possibly be related to the fairly large fall in the value of the rupee from 12.56 Rs./SDR in 1985 to 20.80 Rs./SDR in 1989. With the sharp fall in the value of the Rupee, the small increase in Dollar or SDR terms was translated into a large increase in Rupee terms.

Quite clearly, manufacturing exports follow a quite different trajectory from that of domestic industrial output. The direction of year to year movements seems to be quite the opposite in the two cases, though these dichotomies are by no means completely coincident in time. This significance of this fact is developed below.

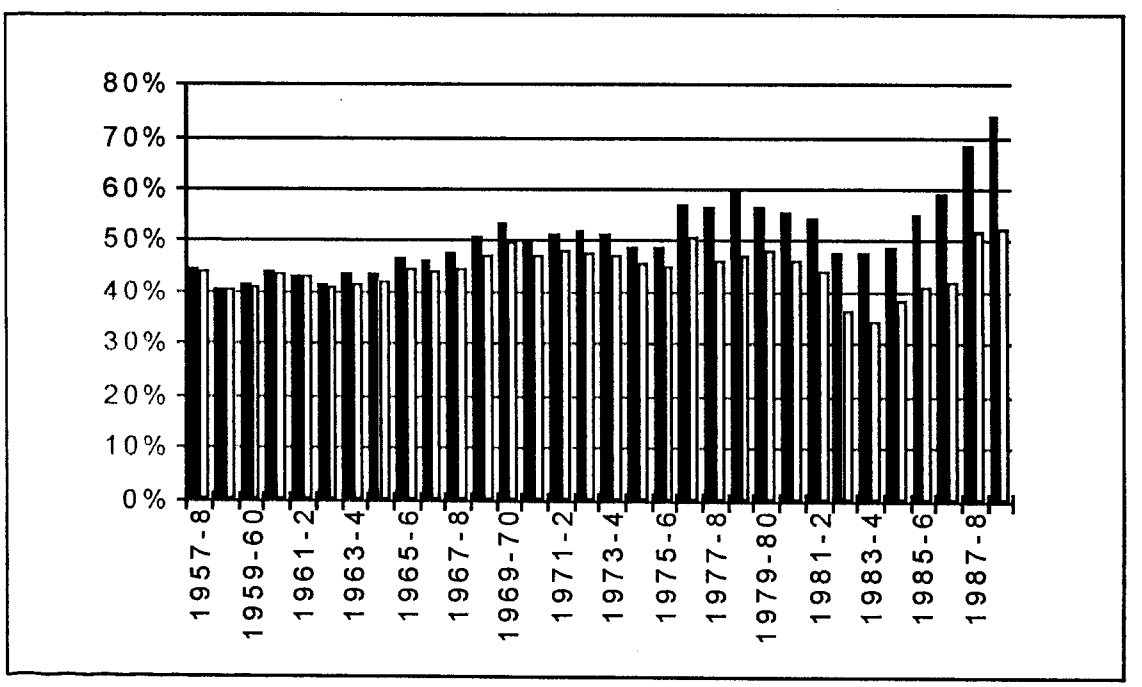

Figure VIII.ii: Non-oil manufactured exports as a proportion of total exports. (Blank columns exclude Gems and Jewellery) Source: Economic Survey, various issues.

Indian export performance in the 1980s reflects trends seen worldwide after the second oil shock, when the proportion of manufactures in total exports increased for LDCs considered as a bloc. LDCs also accounted for a substantially greater proportion of world trade in manufactures.[6] The proportion of Indian exports accounted for by manufactures increased from 56.45% to 68.31% over the period from 1979-80 to 1987-88.[7] The dip to a low of 47.51% in 1983-84 can be explained by the very large exports of oil from Bombay High for a four year period from 1981-82 to 1985-86.

Table VIII.1: Major manufactured exports: (Rs. crore in current prices)

	1960-1	1970-1	1980-1	1985-6	1988-9
Gems and jewellery	1	45	618	1503	4392
Readymade garments	1	29	550	1067	2102
Leather and leather goods	28	80	390	770	1522
Chemicals and drugs	7	29	225	498	1288
Engineering goods	22	198	827	954	2256
Share of all 5 in manufactured exports	20.27%	49.35%	69.66%	75.18%	77.34%
Share of top 3 in manufactured exports	10.31%	19.95%	41.58%	52.40%	53.63%

Source: Economic Survey 1991-92

An analysis of the commodity composition of exports shows that the broad movements can be traced to a few sectors. The major commodity sectors that imparted dynamism to the export sector in the 1980s were

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[6]This increase in the LDC share of trade in manufactures has been traced to the maintenance of export growth in the face of a slowing of world trade. See Faini, et al (1992) p.866.

[7]The proportion was even higher, 73.88% in 1988-89, but this would exaggerate the increase unduly.

gems and jewellery, readymade garments, and leather and leather goods. These were the only manufactured exports in which India had anything other than a minuscule market share by the end of the 1980s.[8] Exports of chemicals and engineering goods also increased very rapidly in the eighties, but these were a very small part of world trade even by the end of the 1980s. These five commodity groups account for a very large, and increasing proportion of all manufactured exports. Gems and jewellery exports, largely in the form of diamonds, were already India's biggest exports by the beginning of the 1980s, and increased their share in world trade substantially. This commodity group dominates export performance and is very import intensive. The connections between the jewellery industry and the rest of manufacturing are weak, which makes it worthwhile to consider the links between exports and domestic industrial performance excluding this sector. The last two sectors in the table above, chemicals and drugs, and engineering goods, display a decreasing share of manufacturing exports, and this translates to a fairly poor performance in real terms over the 1980s.

A brief survey of some studies of Indian exports

In the first decade after Independence, Indian exports did not maintain their market share, and this inability to sustain world export market shares has characterised export performance right through to the end of the 1970s.[9] The "export pessimism" of the early planners was a major

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[8]Here defined as 2% of world exports, and considered at the 2-digit level of the SITC. The only other manufactured export close to the 2% mark was textiles, yarn, fabrics, and made-ups, which had declined to 1.6% in 1989 from 2.3% in 1980 and 4.1% in 1970.

[9]For a discussion of the export sector in the 1950s and 1960s, see Singh (1964) and Nayyar (1976).

factor in the adoption of inward-looking policies of import-substitution. Measures to promote exports were seen as contradictory to import substitution, and were largely non-existent in the 1950s and 1960s.

The shrinkage of India's share of world exports in the period up to the beginning of the 1980s lends support to a view that locates reasons for poor export performance in national factors and policies rather than the external environment. The orientation of policy and high domestic costs of production limited export growth. The absence of "export consciousness" was an additional reason for the slow expansion of exports and the inability to sustain export market shares.[10]

Noting that the share of Indian exports in world trade actually declined in the 1960s and 1970s for a variety of commodities compared with that of several other nations, as well as across commodities, Wolf (1982) attempts to provide some explanation for this poor performance. His conclusions echo those of Nayyar (1976), and the Hussain Committee Report is also in broad agreement. Indeed, a number of the recommendations in the Report of the Committee on Trade Policies are to do with the orientation of policy, which Wolf targets as being particularly responsible for the inadequate growth in exports. In brief, Wolf argued that the structure of Indian industry, and the inability of government to adopt measures that might have overcome the obstacle posed by this structure were responsible for the poor export performance.[11]

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[10]The term "export consciousness" is due to Nayyar (1976).

[11]This hypothesis is based on a study of the data, and includes some attempts to estimate real effective exchange rates (EER) and domestic resource costs (DRC) but no econometric investigation, unlike the studies of manufacturing exports considered below.

The measures of export promotion and liberalization of the trade licensing regime first instituted in the second half of the 1970s increased in scope and efficacy, but only slowly. The change in the orientation of policy was a gradual one, and involved a move from removing disincentives to export production to first compensating for the disincentives and then encouraging the development of markets and products. This change in the domestic policy scenario, rather than any change in the external situation can be seen as the critical determinant of export performance.[12]

In many ways, the Report of the Committee on Trade Policies can perhaps be viewed as a reaction to a series of analyses of the Indian export sector - even if it came a little late and trailed actual developments in trade liberalization. This Report is also helpful in as much as it relates export performance to the domestic industrial structure, as well as the reverse, addressing a vacuum in writing on Indian exports.[13]

Export demand functions

Some of the more recent analyses of export performance have focused on manufactures in estimating export demand functions. A theme that has recurred in these econometric analyses is the need for disaggregation. This disaggregation has been pursued by considering a number of sectors as or by looking at relative export prices with respect to different countries or

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[12]Nayyar (1987) develops this view.

[13]A notable exception is the work of Nayyar (1976, 1987). Nayyar was also Member Secretary of the Committee on Trade Policies, and this is perhaps relevant to an understanding of the position adopted in its report.

groups of countries.[14] In these studies, primary emphasis has been placed on the real exchange rate as a determinant of export performance.

An export demand function would be useful as an intervention in the field, but it might be just as useful to treat exports as exogenous. The significant difference is that we are concerned with the demand for manufactured exports in rupee terms rather than with earnings in dollar terms. For the purpose of this dissertation, the important thing is the relationship between exports and overall output in the manufacturing sector. Apart from the emphasis on the relation between exports and domestic industrial performance, the difficulties in estimating Indian export prices are considerable. A particularly difficult aspect of modelling demand for exports is the choice of appropriate deflators, an aspect that is further complicated by the various systems of government incentives for exporters and export promotion schemes.[15] The frequent changes in the export promotion regime further complicate the process of estimating export prices, and there is no accurate account of such things as premia on replenishment licenses (REP), which is necessary to estimate the extent of subsidisation of export production.[16] Hence, no attempt at modelling

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[14]Lucas (1988) reports the results of a study that is based on a disaggregation of manufacturing exports into 23 sectors. Rajaraman (1991) utilises bilateral exchange rates for specific commodities, and Faini, et al (1992) suggest that using just one world price to model export demand may involve a fallacy of composition.

[15]Lucas (1988) comments on some of the issues relating to the choice of deflators. As far as export promotion schemes are concerned, they frequently involve preferential access to imports, credit and raw material and infrastructural inputs, apart from an ever changing set of tax incentives.

[16]Nayyar (1987) uses a rough rule of thumb for estimating REP premia. Clearly, an econometric estimates based on such a procedure would only give an illusion of accuracy.

manufacturing export demand is made here, though a review of some estimates of such demand is undertaken.

In estimating export demand functions for manufactured exports for the period from 1964-65 to 1979-80, Lucas (1988) disaggregates into 23 commodity groups. His work demonstrates that there is a substantial range in price elasticity of demand for different commodities, from below unity to around six, and he suggests that the often reported finding of inelastic demand for developed country manufactured exports may well result from the process of aggregation.[17] Consequently, he advocates a process of policy formulation that takes due cognizance of the differences between different commodity groups, and cautions against the use of the small country assumption in all cases.

A similar note of caution can be found in Faini, et al (1992), who contend that the small country assumption is not valid for India as well as a large number of other LDCs.[18] This study highlights the importance of the relative price of manufactured exports with respect to the North as well as the South. The findings of this study imply that the benefits of devaluation are likely to be insubstantial in the presence of similar devaluations by competing LDCs. The results could also be interpreted to suggest that a country cannot afford not to devalue to keep abreast of competing countries that have devalued. The export demand equation for India estimated by Faini, et al (1992) has relative price terms with respect to both the North and the South that are statistically significant. Certainly,

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[17]For details of such studies, see Lucas (1988) p.70.

[18]Faini, et al (1992) p. 871. The test is performed for the period 1967-83.

this ties in with other studies that emphasize the importance of price in determining export performance.

Rajaraman (1991), for instance, aims to assess the importance of price, as mediated by movements in the real exchange rate of the rupee, in determining export performance for three selected commodities: cut diamonds, carpets and hand/machine tools. Rajaraman looks at bilateral movements in the exchange rate *vis-a-vis* competitors for the period from 1974 to 1987. This period was characterised by considerable short-run movement in the value of the real exchange rate which declined by about 30 percent over this period.[19] The focus is on exports to OECD economies rather than COMECON (formerly) countries[20] and a simple econometric exercise is undertaken to determine the influence of the real bilateral rate of exchange (RBER) on the relative share of Indian exports *vis-a-vis* those of competing exporters.

Assuming separability between import and domestic demands, Rajaraman tests the sensitivity of the relative import shares from India and other producers, considering them one at a time. The results suggest that movements in the RBER are an important influence on market share, though the impact of depreciation is clearly affected by the nature of the commodity in question. For instance, the sensitivity of exports of diamonds, where non-price factors are important, was considerably less than for the other two groups of commodities.

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[19]It has been contended by many that the rupee was "overvalued " prior to this devaluation. For instance, see the Report of the Committee on Trade Policies (1984). See Rajaraman, p.678 for estimates of changes in the real exchange rate.

[20]A logical distinction, given that "exports (to the COMECON) have been...negotiated outcomes rather than the result of market forces". (Rajaraman (1991) pp.669.)

Rajaraman calls for assessments to be made in the real exchange value of the rupee to be made in relation to the exchange rates of competitors in the various export markets in the context of monitoring and short term prediction of export performance, this feeding back to an overall outlook for determining the exchange rate of the rupee. While the importance of such exercises is likely to increase in the future as the market orientation of several of India's trading partners increases, the move towards a floating rupee will obviate the need for the same.

From the more limited viewpoint of our attempt to link export performance to industrial activity and processes of liberalization, this study underlines the importance of looking at specific commodity groups at a disaggregated level, the need to isolate price from non-price factors, and the importance of properly specified export demand functions.

Why exports are treated as exogenous

The evidence on the relative importance of supply factors and export demand in determining export performance is by no means unequivocal.[21] The evidence in the context of Indian manufacturing exports mirrors this feature. It should come as no surprise, that writers in the field urge caution in regarding price as the only or even the primary determinant of export performance. Quality and "export consciousness", the domestic industrial structure, and the framework of industrial and trade policy have all been viewed as significant influences.[22]

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[21]Faini, et al (1992) refer to the debate on the subject as a precursor to their own analysis.

[22]As mentioned earlier, Bhagwati and Desai (1970) and Bhagwati and Srinivasan (1975) provide what are probably the earliest criticisms of the export policy regime.

Only a few of the studies of export demand make any comment regarding the links between exports and the domestic performance of the industrial sector. Nayyar (1987), however, explicitly assesses the impact of domestic demand on export performance. He argues that exports can be seen as a residual sector and increases in domestic demand squeezes the 'surplus for export', by making export production relatively less profitable and therefore less attractive than production for domestic consumers. While this phenomenon is cited as being particularly characteristic of primary commodities and agro-based manufactures, it may have more general relevance.

Aside from the conceptual difficulties in developing a useful formulation for manufactures' export demand, limitations imposed by the available data are considerable. The choice of the appropriate degree of disaggregation, and the choice among ER, RER, RBER, NEER, REER are themselves difficult ones.[23] Ultimately, the choice of deflators and exchange rate index is likely to be dictated more by reasons of convenience and availability, and would only perpetrate an illusion of analytical precision.

In econometric terms too, the estimation of export demand functions poses difficult problems. As in any demand estimation exercise, it is important to demonstrate that the price (exchange rate) determination

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[23]Joshi (1984) utilises the nominal effective exchange rate (NEER) and the real effective exchange rate (REER). Joshi (1984) and Joshi and Little (1989) contend that movements in the REER are important in accounting for movements in exports between 1974 and 1985. Nayyar (1987) contests this view, arguing that the turning points in export performance do not support the argument that movements in the REER determined trends in exports, which, in any case reflects *post hoc ergo propter hoc* reasoning.

process is independent of demand. It is quite likely that the underlying determinants of the exchange rate and export demand could not be distinguished. Furthermore, there are issues concerning the time-series characteristics of the variables being modelled, and little attention has been paid to the possibility of spurious regression in the studies considered earlier.

To reiterate, the focus here is on the impact of export demand on industrial production. There is little question that export demand helped certain sectors, but did these sectors achieve much by way of forward and backward linkages, and spillover effects, or even demand creation?

The impact of export performance on industrial expansion

One factor that has an important bearing on nature and extent of the impact on the domestic economy of increased exports is the import intensity of that export production. The figures below reveal that manufacturing exports in the 1980s were characterised by increases in the proportion of imported inputs.

Table VIII.2: Import intensity of exports in the 1980s

	1980-1	1985-6	1988-9
Import intensity of all exports	21.2%	26.1%	41.7%
Import intensity of manufactured exports	38.0%	44.7%	57.8%
Import intensity excluding gems and jewellery	32.1%	35.9%	51.7%

Source: Export-Import Bank of India (1991)

The figures presented above are based on import licences issued to registered exporters and export promotion schemes, and only give a rough idea of the import intensity of exports. Exporters could also import inputs

on Open General Licence, and such imports are not included in the figures above. The imports on licence are likely to have been used primarily in manufactured exports. Figures for manufactured exports also reveal that there was an increase in the import intensity of export production. Excluding the very import-intensive gems and jewellery sector does not alter the trend in increasing import intensity.[24]

In terms of aggregate demand effects, this increasing intensity of import use reduces any positive impact that increasing manufacturing exports might have had. Even with a relatively stable import intensity, the rising share of manufacturing exports in all exports would imply that any potential increase in aggregate demand was correspondingly diminished.

Quite apart from the fact of rising import intensity, the expansion in exports and domestic production in the manufacturing sector does not coincide either in time or across commodity sectors. On the contrary, the periods of fastest export growth were periods of sluggish domestic expansion, with the exception of the period after 1986, when the devaluation of the rupee was so large as to make export production attractive even in the presence of buoyant domestic demand and fairly rapid growth in industry. Comparing the fastest growing export areas with the sectors that recorded the highest growth internally also reveals a startling dichotomy. There seems to be only a limited connection of export production to domestic production and profitability, and it seems as

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[24]The Exim Bank study also derives figures based on primary data, but these figures are only available for the period from 1985-6 onwards. The figures for import intensity appear to be lower than the rough aggregates at 38% for the subset of manufactures' exports considered in 1989-90.

if spillover effects, externalities and economies of scale between the two markets are inconsequential.

Ultimately, it would appear as if neither "growth-led exports" nor "export-led growth" adequately characterise the Indian manufacturing experience. The overall vibrancy of the industrial sector seems to be one of a large number of factors that influences export performance. Similarly, export demand does not appear to have exerted a very significant impact on domestic industrial production. This should provide sufficient justification for treating export demand as exogenous for industrial production.

Private sector demand

The models of demand for industrial consumption and producer goods developed in this thesis suggest that there was an evolution of demand patterns in the 1980s that was consistent with patterns prevalent in the previous decades. The models possess adequate explanatory power and exhibit good forecast performance.

The increase in aggregate demand in the 1980s should be viewed in terms of these models in combination with the enhanced demand from the public sector and the perspective offered in this chapter on the role of exports. Changes in the underlying variables, themselves shaped by the evolution of the economy, altered the structure of demand and provided an impetus to industrial production.

In the next chapter, I examine the nature of the supply side of the industrial sector in light of the changes in the policy regime and possible supply responses which could have manifested themselves in the form of productivity improvements.

IX

THE SUPPLY - SIDE OF INDUSTRIAL EXPANSION: A DISCUSSION OF PRODUCTIVITY

The discussion of the demand for industry sets the stage for a consideration of the supply-side. An independent role can be ascribed to the supply-side in the context of liberalization of policy. In this chapter, I consider possible innovations in supply that could have aided the acceleration in the growth of output.

To provide a framework for examining the issues of productivity and growth in industry, I briefly discuss the Solow growth-accounting approach and the 'new' growth theories. The changing conditions in the labour market provide a backdrop to an assessment of multi-factor productivity change. I develop a model of the supply-side that combines features of the growth-accounting literature and recent contributions on the subject of long-run growth in an econometric framework that incorporates the recommendations of recent research in time series econometrics. I conclude the chapter with an assessment of the connections between liberalization, productivity and growth.

Ever since the innovations in the field of economic growth achieved by Solow in the mid-1950s, an enormous amount of attention has been devoted to the role of productivity in increasing the output of nations.[1] The work of Denison was among the first to emphasize the quantitiative

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[1]These papers are Solow (1956) on the theory of growth and Solow (1957) on technical change. For a survey of the contribution of Solow to growth theory, see Dixit (1990).

significance of the 'Solow residual' in accounting for growth. Ever since, the field has been characterised by an interplay of theory and empirical testing that has posed new questions and provided various insights for policy.[2] The shift from capital accumulation to productivity growth as the means of development involved a move away from the Harrod-Domar type of analysis and attendant policy prescriptions to one that emphasized methods of increasing the efficiency of utilisation of the factors of production.

The Solow residual, in its context of perfect competition, constant returns to scale and the absence of externalities, measures shifts of the production function and is meant to be uncorrelated with any factors that lead to an increase in output. However, the empirical evidence suggests that there is a procyclical movement in productivity growth, and that the Solow residual is in fact correlated with a number of variables that should, assuming that the theory is a valid description of reality, have no influence on the level of productivity.[3] It has also been suggested that the framework of perfect competition is not entirely appropriate for the analysis of cyclical behaviour and this criticism of the Solow approach is of particular relevance in the context of Indian industry. The Solow growth model is similarly unable to account for the apparent connection between rates of investment and rates of growth across national economies, and

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[2]Denison (1962) provides one of the first examples of growth accounting, along with Griliches and Jorgenson (1966). An updated view is available in the more recent work of these early practitioners, in Denison (1979) and Jorgenson, et al (1987). A discussion of productivity growth in British manufacturing is available in Muellbauer (1986).

[3]For a statement of the invariance proposition and an investigation of the properties of the productivity residual, see Hall (1990).

there continues to be controversy regarding the convergence of growth rates between different economies.[4]

More recently, theory has shifted to 'endogenous' explanations of growth to take account of some of the limitations of the original Solow analysis. The ideas that underlie the 'new' growth theories can be traced to views that were advanced in the 1960s, as in the contributions of Romer (1986, 1990) and Lucas (1988). These 'new' theories emphasize the importance of 'human capital' and increasing returns in explaining growth trajectories.[5] The new theories are at the heart of attempts to account for the still substantial differences between growth rates internationally and the impact of national policies on growth, since it is quite possible in the context of these new models to have multiple non-convergent growth equilibria based on endogenous growth.[6]

The work of Scott (1989, 1992), in particular, regards the lack of correlation of the Solow productivity residual as a non sequitur. For Scott, investment is the vehicle for the introduction of innovation and the

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[4]See Romer (1987), Solow 's Nobel Prize address (1988) and Summers (1990). On convergence, see Baumol and Wolff (1988), Barro and Sala-i-Martin (1992) and Chatterji (1992).

[5]For a review and assessment of the new growth theory, see Easterly, et al (1992), Boltho and Holtham (1992) and the review in Ch. 1 of Chenery, et al (1986). Lucas (1988) is a development of the work of Uzawa (1965), and Romer (1986) can be seen as developing the ideas of Arrow (1962) on learning by doing. See also King and Robson (1992) who introduce the idea of learning by watching.

[6]Easterly, et al (1992) set out the ambitious agenda of the World Bank to assess the impact of national policies on long-run growth. See Matsuyama (1991) and Krugman (1991) on the possibilities of non-convergent multiple equilibria.

ultimate cause of all productivity enhancement and 'unexplained growth'. While discussions of measurement errors in explanations of the growth residual are not new, Scott provides a fresh perspective on these so called measurement errors, by proposing that a more adequate explanation of growth could be obtained by the use of gross investment figures. In his view, it is misguided to employ measurement errors and growth accounting to apportion output growth among different candidates. In his view, gross investment captures the change in the capital stock, and provides a better explanatory variable for the change in level of output and thus, of growth.[7]

For Scott, it is not just particular types of investment, as Lucas (1988), Romer (1990) and Barro and Sala-i-Martin (1990) suggest in their emphasis on human capital, research and development, and public infrastructure respectively, but investment in all areas that is crucial for an explanation of growth. This view of investment underlies the attempt in Scott (1989) to explain differences in growth rates between developed countries, using only the rate of growth of quality adjusted employment and the share of gross investment in output. For Scott, it is unimportant, even irrelevant, to account for growth in the Solow sense. The analysis of the supply side of the industrial sector below is similar in spirit to the work of Scott, although there are substantial differences in the specifics of the two approaches.

The multiplicity of policy conclusions that emerge from the literature are a direct result of the inconclusive evidence that investigations of growth

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[7]Scott (1989 and 1992) insists on the use of gross investment figures rather than net investment in attempting to track the dynamics of output.

have provided. Theoretical issues such as non-convergence and the possibility of non-unique multiple growth equilibria have been brought into sharp focus in empirical investigation, leading to a plethora of policy conclusions, often conflicting with each other. Broadly, however, the new growth theories have served to renew emphasis on increasing savings and investment rates through policy measures. The direction of investment is seen as critical by some, but the consensal view emphasizes that both the volume and the efficiency of investment need to be raised.[8]

These themes are not really new, in as much as development theorists have debated the importance of such factors in achieving sustained growth for some time. The ultimate importance of these more recent contributions derives from the fact that they have focused mainstream theory on issues of growth and development and helped operationalise these concepts in a manner that lends itself to quantitative investigation. The limited success of the endogenous growth models in empirical implementations, however, suggests that these models are best used in multi-country studies to study differences in international experiences of growth, rather than to isolate the factors that may have determined the extent and pattern of growth in any particular economy.[9]

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[8]Summers (1990) suggests that the social rate of return from investment is greater than the private return to investment, and hence espouses policies that raise investment. Scott (1992), King and Robson (1992) and Easterly, et al (1992) among others provide an analysis of policy implications arising from the new growth theory.

[9]Easterly, et al (1992) in the statement of their research agenda based on the new growth theories, point to this shift from 'analyzing the "factor sources of growth",' to 'analyzing the "policy sources of growth".' (p. 7).

The controversy on the ultimate determinants of growth has not been settled, but it is impossible to deny that the various contributions to the theory of growth have, in the course of their enrichment of the field of growth and development, underscored the importance of a variety of factors influencing economic growth. Perhaps the debate will never be completely resolved, and will continue to provide an imperative for further innovations in thought - novel approaches that will illuminate any discussion of growth - and supply an ever growing range of choices to policy makers desiring promotion of economic growth.

In India, discussion of economic growth has had little to do with the importance of productivity improvement and increases in efficiency as a means of achieving growth. The legacy of extensive growth that derived from the tradition of Harrod and Domar, and drew further support from the ideology of Soviet Planning was very much at the center of ideas on planning and growth as developed in the Second Five Year Plan and in subsequent policy documents. Capital accumulation was seen as the key to growth, with little or no emphasis placed on productivity growth. Simply speaking, the plan involved raising the rate of capital accumulation until a higher rate of growth was achieved. The issue of productivity only receives a mention in the Industrial Policy Statement of July, 1980 when "maximum production and achieving higher productivity", was spelled out as a socio-economic objective.[10] It is not clear, though, what concrete measures the government could have taken to raise productivity, even if this recognition had been achieved earlier. Unlike investment or other

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[10]From "Objectives of Industrial Policy Statement of July, 1980", reprinted in GOI (1991), p. 95. The Industrial Policy Statement of 1991 also mentions the emphasis on productivity in the Sixth Five Year Plan. See GOI (1991) p. 99, para. 6.

kinds of expenditure, productivity can only be raised indirectly, and no method, simple or otherwise, offers a guarantee of success.

Tragically, the experience of growth in the Indian economy seems to reflect this neglect of productivity. The industrial sector, which is also the only sector to have been investigated for the existence of such productivity changes in a systematic manner, has been characterised by low rates of measured total factor productivity growth. The attraction of invoking an explanation that operates in terms of measurement errors seems obvious, but it should soon be quite clear that measurement errors would have been a useful explanation if there was such a residual that needs explanation. Unfortunately, there does not appear to be any such residual that needs to be accounted for.[11]

Productivity in Indian Industry

This brief section reviews some issues in relating to productivity in Indian industry. The main conclusions of three of the more reliable studies on productivity are presented, as are the results of an exercise to account for inter-industry variations in total factor productivity growth (TFPG). Studies aimed at discovering the possible existence of, and quantifying the extent of, productivity growth in the context of Indian industry became more common following the work of Nishimizu and Robinson (1984). Such research has been directed mainly at explaining the slowdown in the sixties in terms of total factor productivity growth.

The issue of the extent of TFPG in Indian industry is as yet unsettled even for the first 15 years of planning (1951 - 1965); estimates vary from a small

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[11] Pun intended.

decline in the aggregate to a 2.8 % annual rate of growth, or a contribution of nearly half to the overall rate of growth.[12] There are many causes for this lack of consensus.

The estimation of productivity growth involves several difficult conceptual issues and the choice of the measure for this aggregate is itself contentious.[13] A more serious drawback in the Indian context is the reliability and availability of statistics. Reliance has to be placed on the ASI data for estimates of input use[14] - such figures are available for the period 1959/60 to 1985/86. However, there are no figures for 1972/73, and the classification was changed after 1973/74 for the 'factory sector' of the ASI,[15] accounting for about 90 % of all value-added, and accepted as the more reliable part of the data. In addition, response rates vary between years for these statistics.

In the context of the many attempts that have been made to examine industrial growth in terms of productivity change, it must be pointed out that movements in productivity are often the ex-post results, rather than the ex-ante causes, of variations in growth. Hence, evidence that output

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[12]See Krishna (1987) for the details of these studies.

[13]Krishna (1987) provides an overview of the different indexes of productivity employed.

[14]These include information on material input, electricity consumed, man-hours worked, wage rates and fixed capital. Also, measures of output and value added are made available.

[15]Includes firms employing at least 50 workers with power, or 100 without power. The Sample sector includes firms that employ at least 10 workers with power or 20 workers without.

growth has been low in relation to a composite index of labour, material input, and capital employed, should be interpreted with care.

The observed correlation between output growth and productivity suggests that expansion in output could itself be a major influence on productivity growth. The continued existence of substantial levels of excess capacity in industry in the period of high growth in the 1980s, suggests that demand factors have a critical role to play. Ex-post high levels of excess capacity could be manifestations of inadequate demand as well as supply inadequacies.[16] This underutilisation of capacity was possibly influenced by such factors as imperfect competition, high prices of variable inputs, sunk costs, and irreversibilities.[17]

Movements in TFPG

The results of what are regarded as the most reliable studies of TFPG for the sixties and the seventies are presented here. Goldar (1986) estimates TFPG for the period 1959-79 in two parts, breaking the study at 1965.[18]

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[16]This is acknowledged by Goldar (1986 a).

[17]Berndt and Morrison (1981) and Morrison (1985) trace levels of capacity utilisation to the costs of adjusting quasi-fixed factors.

[18]The study also presents results using data from the Census of Manufacturing Industries for 1951-65; only the results utilising ASI figures are reported here.

TABLE IX.1: TFPG in Manufacturing: (Average annual %)

Measure	1959-65	1965-70	1970-79	1959-79
TFP (Solow)	1.29	0.87	1.53	1.29
TFP (Translog)	1.33	0.96	1.49	1.31

Source : Goldar (1986)

The figures display virtually no change in terms of TFPG between the 1959-65 and 1959-79 periods. Though there is an improvement in productivity enhancement in the seventies in comparison to the sixties, this mirrors the greater increase in capital intensity that occurred in the period from 1959 to 1970.

TABLE IX.2: TFPG (Solow): Registered Manufacturing (Annual average %)

	1959-66	1966-80	1959-80
All Manufacturing	-0.3	-0.7	-0.6

Source: Ahluwalia (1985).

Ahluwalia's 1985 study concurs with the Goldar finding that productivity growth was little changed in the period of deceleration in comparison to the first half of the sixties.[19] However, she finds evidence of a decline in overall productivity, a phenomenon that holds true at the two-digit level for all but five of the industry groups. She also reports that several of the

[19]There is no break in the study at 1970 that allows direct comparison with the Goldar study.

industries that suffered a decline in growth improved in terms of productivity, which is not entirely surprising and could well be a result of the forced obsolescence of older equipment.

The different conclusions reached by Goldar and Ahluwalia can be traced to differences in methodologies adopted. However, some broad conclusions can still be safely derived from these studies - i. Productivity growth was small, if positive at all (the Lucas computable general-equilibrium analysis for the twenty years since 1960 also reveals little evidence of disembodied technical progress.[20]); ii. There are significant inter-industry variations in productivity growth; iii. The deceleration in industrial growth since the mid-sixties was due to factors other than a decline in productivity growth.

Goldar (1986 a) attempts to account for the inter-industry variations obtained by Ahluwalia (1985) in terms of output growth (Q); the relative contribution of import substitution to change in output (S); a concentration ratio to capture monopoly power and the exploitation of scale economies (C); the change in this ratio (ΔC); and a unionization index based on man-days lost in industrial disputes (M).

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[20]Lucas (1989).

TABLE IX.3: Cross-Sectional analysis of TFPG for 19 industries: 1959-79.

Variable	Q	S	C	ΔC	M	Constt
Parameter estimate	0.55	-0.053	-0.048	0.35	-0.06	-1.39
t-statistic	2.96	-2.05	-1.41	1.58	-0.20	

R^2 = 0.55; Adjusted R^2 = 0.38; F = 3.22.

Source: Goldar (1986 a)

The regression suggests that output growth was an important influence on productivity growth, and suggests that Verdoorn's Law has some validity for the industrial sector.[21] This law pertains to a dynamic relationship between the rates of change of output and productivity, and such a relation, not necessarily a consequence of scale economies, appears to fit the Indian industrial context well. The other statistically significant variable is the import substitution index which appears to have had a negative effect. However, the specification leaves much to be desired, and

[21]Kaldor (1966 pp. 106) provides a statement of this Law. It is the

> "empirical relationship between the growth of productivity and the growth of production which has recently come to be known as the "Verdoorn Law",.... ..(it) is a phenomenon peculiarly associated with the so called "secondary" activities - with industrial production, including public utilities, construction, as well as manufacturing - rather than with the primary or tertiary sectors of the economy."

For a more recent view, see Scott(1989).

the predicted values fall short of the actual changes for "most industries".[22]

The procyclical variation of productivity, as well as the link between productivity growth and "variables known to be neither causes of productivity shifts nor to be caused by productivity shifts"[23] have been reported and studied in several other contexts.[24] The fact of procyclical movements in productivity does not imply in itself that technology shocks led to the increase in industrial growth. The violation of the invariance postulate implied by the correlation of the productivity residual with measures of import substitution, market power, and unionization, makes it difficult to sustain the argument that productivity shocks were responsible for initiating the increase in growth.

Ahluwalia (1991) provides the most recent perspective on productivity and growth in Indian manufacturing. In addition to reviewing the existing literature, her work looks at TFPG in manufacturing and attempts to link the acceleration in industrial growth in the 1980s to an improvement in TFPG performance. The painstaking analysis of industrial productivity at a highly disaggregated level suggests that there was a turnaround in the TFPG performance after 1982-3, and that this reversal in productivity change was fairly widespread among the different industries. The pervasiveness of the improvement in productivity

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[22]Goldar (1986 a).

[23]This is part of the statement of the invariance of the Solow residual in Hall (1990) p. 74. Hall also demonstrates that imperfect competition is not the source of the failure of invariance.

[24]For instance, see Baxter and King (1990) and Rotemberg and Summers (1990).

provides support for an aggregative view. This support for macroeconomic influences, rather than sector-specific changes, is an additional buttress for the aggregative approach adopted here.

At the intermediate level of disaggregation by four categories of end-use, the results are as follows:

Table IX.4: Estimates of Production Function Parameters : Translog form (1959-60 to 1985-6) and Cobb-Douglas form (1961-2 to 1985-6).

	Returns to scale	Capital coefficient	TFPG 1959-60 to 1982-3	Shift in TFPG after 1982-3
Intermediate goods	Not-constt		-1.0	0.8
(Cobb-Douglas)	Constant	0.32	-0.2*	0.4
Consumer non-durables	Not-constt		0.0	0.9
(Cobb-Douglas)	Constant	0.52	-0.7*	0.7
Consumer durables	Not-constt		2.5	1.1
(Cobb-Douglas)	Constant	0.32	1.7**	0.8
Capital goods	Not-constt		1.1	0.0
(Cobb-Douglas)	Constant	0.18*	3.0	0.2*

(Table adapted from Ahluwalia (1991) pp.163 and 165. For Cobb-Douglas estimates, * indicates coefficient not significant at 5% level, and ** indicates significance at 10% level and not at 5% level.)

Ahluwalia contends that there was an improvement in TFPG in all the sectors aggregated by end-use after 1982-3 apart from the capital goods sector.[25] She attributes this improvement in TFPG to improvements in output per worker, but also draws attention to the relatively constant levels of capital productivity in the 1980s. This constancy in capital productivity marks a change from previous periods characterised by declining output per unit capital - productivity change improves from a decline to constancy or marginal improvement.

In analysing the inter-industry differences in productivity growth in the 1960s and 1970s, Ahluwalia finds a strong positive association of TFPG with the growth of value-added, and a negative association with import substitution and the capital-labour ratio.[26] For this thesis, the location of the increase in productivity in the the period after 1982-83 is important, as is the fact that TFPG seems to be associated with the increase in output growth.[27]

This implies that output growth accounts for the variation in productivity change across industries. Probable avenues of productivity are the realisation of economies of scale and other mechanisms such as 'learning by doing'. Differential degrees of import-substitution deriving from the

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[25]The figures reported above suggest that the figures should be interpreted with great caution, given that the Cobb-Douglas estimates are poorly determined. The translog function estimates are not accompanied by any guide to the statistical significance of the coefficient values.

[26]Again, this is in violation of the Solow 'invariance' proposition. See Hall (1990).

[27]Strictly speaking, the association is with growth in value-added, and the methodological problems associated with the estimation of TFPG are ignored.

disparate effective rates of protection could also have contributed. In addition, changes in the oligopolistic structure of the producing firms were a possible influence, though the evidence on this is equivocal.[28]

TFPG recorded in industry was low, if not negative, in the period of slowdown. However, the variation in productivity change across sectors was substantial. In the next section, these salient aspects of productivity in industry will be located in the context of the various possible influences on changes in industrial output.

Why look at the supply-side?

The rationale for liberalization derives from a perception of constraints on the range of actions available to producers. Industrial policy in India has always involved a curtailment of the scope of firms to pursue their objectives. The success of the process of liberalization relies on the relaxation of some of the constraints on firm behaviour. The changes in industrial policy made in the 1980s have focused on enlarging the freedom of action that firms can take, and liberalization was designed to work through the supply route. Therefore, any evaluation of the liberalization experience must study the supply side.

Changes in the supply side can be seen as necessary, but not sufficient, evidence of the efficacy of policy change on the real economy. Changes in the supply side can be dichotomised into those that have an impact on supply bottlenecks or input use and those that affect productivity. This dichotomy corresponds to the distinction between movements along a

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[28] As measured by the "concentration" indexes in Goldar (1986 a). This change in market power could cut both ways, and, in any case, is poorly determined.

production function and shifts of the production function itself. The relaxation of supply constraints on production could involve various types of input aside from labour and capital, such as electricity and fuel, and raw materials.[29]

Despite its limitations, the Solow-type total factor productivity approach provides a framework for analysis for which a reliable, easily implementable, substitute has not been provided by the new endogenous growth theory. The work of Scott (1989), however, does provide some guidelines which appear to have a sound econometric basis, and the modelling of the supply side that follows can be viewed as a hybrid of the two approaches that takes explicit cognizance of the time-series features of the model variables.

The time-series production function used to model the supply of industrial output provides a perspective on the issue of productivity as well. The concept of productivity is different from the Solow measure of total factor productivity, but is related to the central idea of shifts in a production function. An adequate model of industrial output based on factor inputs - one that takes due cognizance of the particular features of the Indian economy - provides a sound basis for a discussion of productivity change as well.

In keeping with the overall approach of this dissertation, I rely on time-series methods to locate the influence of inputs and changes in the supply situation generally on the upsurge in the rate of growth. The theoretical

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[29]This kind of an approach is usually captured in the form of a KLEM type of production function. Lucas (1989) adopts such a method in his discussion of industrial and trade licensing regimes in India.

preconditions for the standard production function approach are not fulfilled in Indian industrial practice, and this encourages the use of a data coherent modelling methodology that permits a consideration of issues such as model (mis-)specification. This investigation of the supply-side also considers the possible differences deriving from the customarily employed gross output and value-added methods used to measure productivity.

Labour productivity

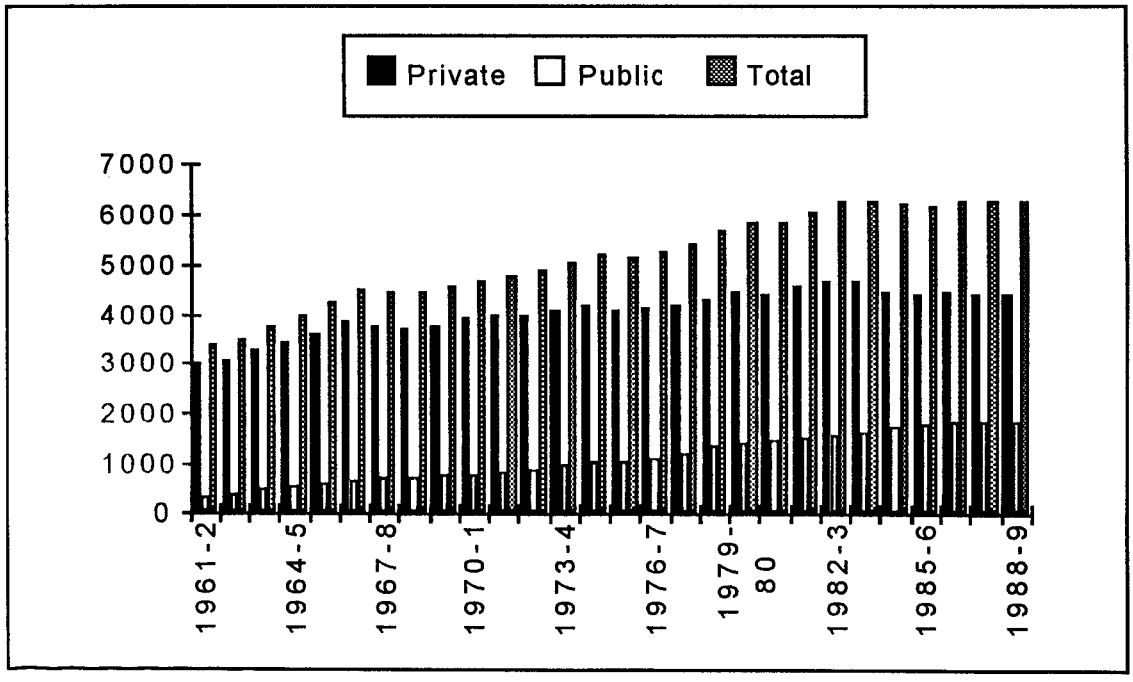

Figure IX.i: Employment in manufacturing - private and public sectors. (Source: Economic Survey, various issues; as measured on March 31 of the initial year)[30]

[30]Figures in thousands; relates to establishments employing 10 or more persons for the private sector; and all employment for the public sector.

Changes in the organised labour market in the late 1970s and the 1980s seem to have drastically diverged from the rest of the reforms in policy. The changes to the Industrial Disputes Act in 1976 and 1982 made it more difficult to fire workers, adding a new dimension to the imperfections of the labour market. Reforms of this vital aspect of the industrial economy have not taken place, and changes that might permit redundancies of labour, and allow the exit of unprofitable producers, do not seem to be forthcoming. As a result, flexibility of producers continues to be limited.

From the restricted perspective of an attempt to measure changes in productivity and estimate a production function for the industrial sector, the relative fixity of the labour input poses a difficult problem. The increases in industrial sector output in the 1980s took place against a backdrop of employment stagnancy in registered manufacturing, as shown in the figure above. It is this stagnation in industrial employment that finds a reflection in great increases in crude labour productivity (product per worker), and colours the results obtained from investigating the supply-side.

Fallon and Lucas (1992) estimate dynamic labour demand equations for 35 separate manufacturing industries for the period 1959-60 to 1981-2.[31] They find that the level of demand for employees shifted downward for a large number of industries following the 1976 Amendment to the 1947 Industrial Disputes Act.[32] The weighted average drop in long-run

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[31]Using ASI figures for the Census Sector.

[32]The Amendment requires industrial establishments to obtain the prior permission of the government to lay off or retrench even a single worker, and makes closure without permission illegal.

demand for employees, at given output levels, is put at 17.5%, with the greatest impact on private sector industrial units and those in which labour union membership was low.

This legislation prompted a shift towards casual and temporary workers to circumvent the regulations pertaining to permanent workers. It should not be surprising to discover that there was a limited increase in employment in manufacturing. It is startling that employment in manufacturing in the private sector actually declined in absolute terms after 1982-3.[33] Only the continued increase in employment in public sector industry, already facing charges of over-manning, allowed overall (permanent) employment in industry to be maintained in absolute terms in the 1980s.

This stagnation in employment provides the backdrop for a discussion of multi-factor productivity. If output per worker grew, both because of an enhanced rate of output growth and a reduced rate of growth of employment, the impact on TFPG can be expected to have been favourable. The underlying reasons that induce an improvement in TFPG are as important as the fact of improvement itself. It is also equally important to bear in mind that figures for the employment of casual labour are simply unavailable. This prevents adequate measurement of labour input in a scenario in which substitution away from the measurable component of labour input may have occurred.

This legislation was initially binding on industrial units employing 300 or more workers, but the coverage was extended in 1982 to all units with at least 100 workers.

[33]Employment in the private sector in the electricity, gas and water supply industries is extremely limited (41,000 in 1989).

Two approaches: value-added and gross output

Methods to measure total factor productivity can be divided into two main types - those based on a value-added production function and those based on a gross production function.[34] Usually, the choice between the two is dictated by the nature of the statistics available. Both sets of figures are available for India, though the span of data necessary for gross output functions is shorter, probably explaining why most analyses of productivity have utilised the value-added approach.

The value-added production function is usually expressed in the form:

$$VA = v\ (L, K, t) \qquad \text{(IX.1)}$$

where VA = value-added, L = labour input, K = capital employed.

An econometric equation corresponding to this is the Cobb-Douglas form (all values in logarithms):

$$va_t = \text{constant} + \alpha l_t + \beta k_t + \pi t \qquad \text{(IX.2)}$$

Usually, the coefficients are restricted ($\alpha + \beta = 1$) to ensure that the production function exhibits constant returns to scale. Differencing this equation yields a form more appropriate to the orders of integration of the modelled series, and allows the identification of the structural parameters:

$$\Delta va_t = \alpha \Delta l_t + \beta \Delta k_t + \pi \qquad \text{(IX.3)}$$

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[34]Jorgenson (1985) provides a review of the empirical literature on production function estimation. Muellbauer (1986) outlines some of the problems faced in implementing production function approaches to the measurement of MFP (multi-factor productivity).

The existence of a stable long-run relationship could provide a basis for combining the two forms above in an error-correction mechanism. The analysis applies equally to the gross-output form of the production function.

$$GO = g\,(K, L, E, M, t) \qquad \text{(IX.4)}$$

where GO = gross output, E = electricity input, M = raw material input.

Neglecting electricity inputs (E), this function can be represented in the following form:

$$go_t = \text{constant} + \omega k_t + \sigma l_t + \nu m_t + \mu t \qquad \text{(IX.5)}$$

On differencing, this yields:

$$\Delta go_t = \omega \Delta k_t + \sigma \Delta l_t + \nu \Delta m_t + \mu \qquad \text{(IX.6)}$$

Both the value-added and the gross output approaches are used below, with differing degrees of success.

It should be noted that

$$GO = VA + \text{Material input} \qquad \text{(IX.7)}$$

$$\text{But, } VA = v\,(K, L) \qquad \text{(IX.8)}$$

Therefore, GO = g (K, L, E, M) should be expressible as

$$GO = v\,(K, L) + j\,(E, M) \qquad \text{(IX.9)}$$

This is the condition of additive separability. In this way, both the gross output and value added methods should provide reasonably similar estimates of productivity change.

Usually, in estimating the extent of multi-factor productivity change using the value-added production function, the parameters (α and β) are set equal to the shares of capital and labour in value-added, and the productivity residual is captured by the time coefficient.[35] The theoretical assumptions necessary for such a clear correspondence to be drawn between TFPG or the shift in the production function and the residual are stringent, and it is questionable whether they are actually satisfied anywhere. Certainly, in the clearly oligopolistic structure of Indian industry, these conditions are not likely to be satisfied.

Some problems with production function approaches to the measurement of productivity

Research on productivity has highlighted the significance of measurement errors.[36] The need to utilise appropriate measures of inputs or apply corrections to the figures available arises from the specificity of the theoretical measure of productivity employed in the exercise. A theoretical distinction can be made between improvements in pure total factor productivity and improvements in 'efficiency' but in practice this distinction is difficult to implement.[37]

In the context of Indian industry, the form of available figures on factor inputs makes it difficult to distinguish between changes in efficiency and

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[35]Ahluwalia (1991) provides an example in the context of Indian industry.

[36]See, for instance, explanations 4, 5 and 6 in Hall (1990, pp. 94 - 100) that rely on measurement errors to attempt to account for the Solow productivity residual. Also see Muellbauer (1986).

[37]Lasserre and Ouellette (1991) attempt to distinguish between the two by the use of shadow prices.

increases in productivity. A consistent series on capital stock utilisation rates does not exist, and any aggregate series would have to be derived with the use of arbitrary assumptions. However, the evidence suggests that levels of capacity utilisation did not alter significantly over the long term, though the year to year variation was substantial. The use of aggregate figures for capital stock in this context is likely to reduce the extent of the mis-measurement.

Table IX.5: Capacity utilisation rates (%) (Average is for 1980-81 to 1990-91)

	1980-1	1981-2	1982-3	1983-4	1984-5	1985-6	1986-7	1987-8	1988-9	Average
Basic	57	61	63	60	64	67	67	70	70	65
Consumer	77	84	74	69	70	70	72	73	70	73
Capital	78	78	78	75	73	69	66	67	76	74
Intermediate	78	74	69	73	76	71	76	78	78	75

Source: Office of the Economic Adviser, Ministry of Industry. (Reproduced in Appendix.)

The measurement of labour input presents problems in addition to those posed by changes in the intensity of work and labour hoarding, which are common features. Fallon and Lucas (1991) point out that the changes in labour laws in 1976 and 1982 altered patterns of employment and led to the increasing use of 'contract' labour and temporary labour to bridge labour shortages, circumvent minimum wage legislation and regulations pertaining to child labour, as well as restrictions on firing. Figures on the use of such labour do not exist and the figures on hours of work available in the Annual Survey of Industries do not appear to be consistent over

time. The available series on aggregate employment in registered industry is therefore likely to underestimate true levels of labour input. At the same time, any adjustment of the figures is not likely to have a very sound basis.

It appears that sophistication in the form of the production function may be misleading in the light of the crude nature of the figures on capital and labour, and the absence of consistent estimates of utilisation. The statement of support in Ahluwalia (1991) for a transcendental-logarithmic (translog) function rather than a Cobb-Douglas specification for the production function should, accordingly, be interpreted with care.[38]

Econometric considerations - how is it being measured?

Empirical investigation of total factor productivity has usually relied on received economic theory as a framework for model specification. Usually, econometric modelling considerations have been secondary to the form of the production function employed in attempts to measure changes in total factor productivity.

However, this emphasis on the economic theory that underlies the econometric model often comes at the expense of a clear understanding of the econometric modelling issues. Sophistication and care in setting out the economic theory is frequently accompanied by modelling methodology that does not adequately embody the time-series characteristics of the model variables. The dangers of ignoring issues such as the order of integration of the model variables, and possible non-

[38] Ahluwalia (1991, p. 149 - 150).

stationarity have been stressed in some detail in recent years, particularly since the work of Engle and Granger (1987).[39]

This criticism of attempts to model total factor productivity should not be taken to imply a nihilistic approach to modelling that precludes the use of theory as the basis of econometric modelling. "Measurement without theory" must be avoided, but empirical investigation should be seen as a means to determine what the "correct" model is. If this is to be the case, the econometric model needs to be specified carefully to allow the investigation of different specific hypotheses under the umbrella of a suitable general model.

Specifically, the investigation of total factor productivity growth in Indian industry has largely relied on the estimation of production functions, and such production functions have involved the regression of value-added or gross output on capital stock and labour (as well as electricity and raw material inputs in the case of gross output). Such conditioning of I(1) variables on other non-stationary variables does not allow conventional measures of parameter significance to be interpreted as such, and measures of "goodness of fit" can be quite misleading in such cases. This creates problems for the validity of estimates of TFPG so derived because the parameter estimates obtained cannot be evaluated using t-ratios as is conventional practice.[40]

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[39]References to the large and growing literature on orders of integration, unit roots, modelling of non-stationary series, common trends (a term due to Stock and Watson (1987)), cointegration and modelling methodology are provided at various places above.

[40]This set of issues is quite distinct from those relating to misspecification testing and the lack of such model evaluation in most cases.

Yet, a production function approach offers a useful basis for analysing the supply-side, and looking for possible productivity changes. By modelling output as a function of measured inputs in a manner that is data-coherent, changes in output that cannot be accounted for by changes in input use can be seen as resulting from increases in multi-factor productivity. The modelling of the supply side is thus distinct from the usual approaches to measuring productivity change in the Solow tradition, and should be seen as an unrestricted estimation of a model of output based on input use.

A loose form of this kind offers advantages of two kinds. First, it does not necessitate any assumptions about market structure, and is a general specification of an aggregate production function. In the scenario of rationed markets that are heavily regulated and characterised by oligopolistic firms, this is clearly an advantage. Second, it takes account of the time-series features of the model variables and has a sound econometric basis while simultaneously being faithful to the idea of a production function. The use of an error-correction model allows both of these features to be circumscribed, as it lends itself to a situation of non-clearing markets and is based on an explicit consideration of the characteristics of the model variables.[41] The pressure on degrees of freedom from the small time span of the figures available suggests that the trade-off between parsimony and explanatory power be considered in the ultimate choice of specification, utilising the Schwarz criterion as a differentiating device.

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[41]See Hylleberg and Mizon (1988) and Hendry, et al (1990) on different interpretations of the ECM and its applicability to markets with rationing.

The net capital stock figures provided by the Central Statistical Organisation for the registered manufacturing sector are used in combination with the ASI Factory Sector statistics on employment and value-added.[42] The capital stock figures in National Accounts Statistics offer different coverage than the ASI, but are consistent over time. The usual perpetual inventory method may be inconsistent and biased due to differences in coverage between years, often because of non-reporting units.[43] Since figures on investment and depreciation from a specific year are used to correct the baseline figures, a bias introduced in one year may be carried over to subsequent years in the absence of a mechanism to adjust for the error. The research in this thesis is the first to incorporate the new data on net capital stock in industry, and is also the first to consider the issue of productivity in industry beyond 1985-6.

The results: For industry (including electricity, gas and water supply)

I first consider the entire industrial sector, and repeat the exercise for the manufacturing sector.

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[42]As Ahluwalia (1991) has pointed out, there appears to be a substantial discrepancy between NAS and ASI figures, which has not been reconciled as was past practice. There does not appear to be any official pronouncement on this aberration.

Unfortunately, it was not possible to investigate the nature of productivity for the unregistered manufacturing sector because of the non-availability of employment figures for that sector. Attempting to use figures for employment of the manufacturing sector published in various issues of the Economic Survey in combination with the ASI figures provided completely strange results.

[43]This objection is in addition to the theoretical problems that Miller (1983) points to in the use of the perpetual inventory capital stock measure.

Table IX.6: Integration statistics: Registered industry[44]

Variable	x_t CRDW	Δx_tCRDW	DF	ADF (1)[45]
k	0.021	0.655	-3.43	-2.75
l	0.027	1.127	-2.52	-1.94
va	0.041	1.769	-3.27	-5.00
go	0.022	1.478	-3.51	-4.81
m	0.119	2.027	-2.00	-2.21

(Number of observations: 27, 1961-2 - 1987-8)

C.R.D.W. = Cointegrating regression Durbin-Watson statistic, D.F. = Dickey-Fuller test statistic, A.D.F. = Augmented Dickey Fuller test statistic. For variables that incorporated a time trend, the test statistics were evaluated including a trend. Evaluated using PC-GIVE 7.0. * indicates significance at the 5% level, and ** at the 1% level.

The integration tests attest the need to take account of the orders of integration to circumvent the possibility of spurious regression. A reparametrisation to differenced variables, which also can be seen as theoretically equivalent to production function estimates of the conventional kind, is one possible solution to the problem.

[44]Includes electricity, gas and water supply.

[45]The calculation of the DF and ADF values is sensitive to the inclusion of a trend; the trend was included in the case of all the variables except l.

The limited degrees of freedom militate against the use of a transcendental logarithmic (Translog) specification, and a Cobb-Douglas production function is used here. Testing for constant returns to scale is done using the ratio method below.[46]

Table IX.7: Cobb-Douglas production function estimates: Registered industry - including electricity, gas and water supply: Dependent variable - $(va/l)_t$ [RLS estimates 1959-60 to 1987-8]

	Constant	$(k/l)_t$	l_t	Trend
Coefficient	7.442	-0.145	-0.929	0.056
t-value	2.96	-0.84	-3.75	4.72
Coefficient	-1.952	0.247	-	0.015
t-value	-12.19	1.46	-	2.65

Diagnostics (for the equation without l_t) Adjusted $R^2 = 0.192$; $\sigma = 7.86\%$; DW = 0.82; Normality $\chi^2 = 1.36$; AR 1-3 F (3, 23) = 4.68; ARCH 3 F (3, 20) = 0.50.

This production function form performs poorly, and yields implausible results due to the presence of the I(1) variable, l_t which dominates the I(0) variables.[47] Eliminating the l_t variable makes the results a little more likely, but the model remains ill-determined.

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[46] A zero coefficient on the labour term is an indication of CRS.

[47] By considering ratios, the I(1) variables are rendered stationary.

The results obtained using the differenced variables are presented below. This reparametrisation yields a straightforward measure of TFPG, which is indicated by the size of the constant term.

Table IX.8: Modelling Δva_t [RLS estimates 1960-1 to 1987-8]

	Constant	Δk_t	Δl_t	Trend
Coefficient	0.058	-0.178	0.380	-0.00
t-value	0.74	-0.26	0.68	-0.09
Coefficient	0.053	-0.147	0.403	
t-value	1.23	-0.26	0.835	

Diagnostics (for the equation without the trend) Adjusted R^2 = 0.47;

σ = 7.12%; DW = 1.96; Normality χ^2 = 0.71;

AR 1-2 F (2, 23) = 2.76; ARCH 1F (1, 23) = 2.50.

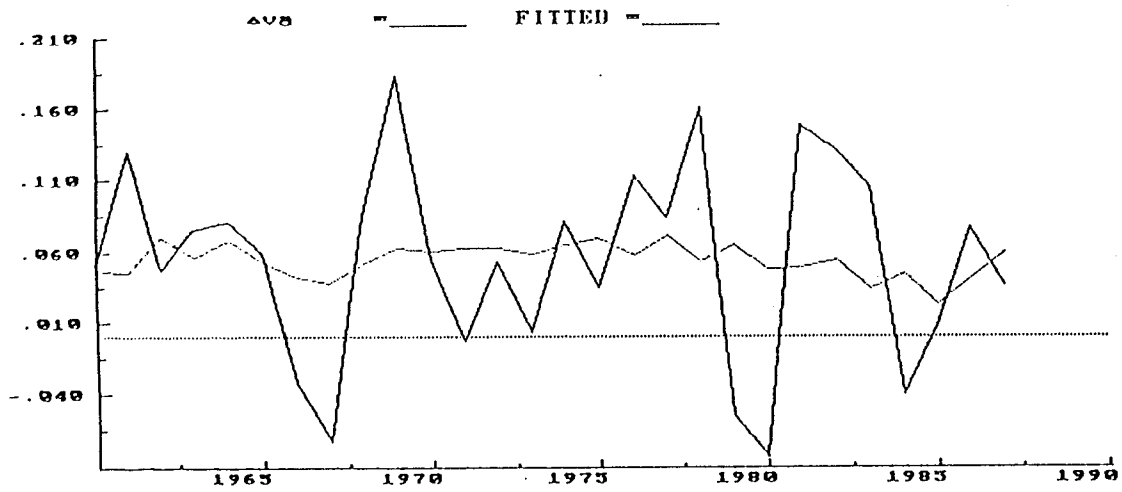

Figure IX.ii: Model of Δva_t for registered industry - Actual and fitted values.

While the coefficient of the constant term indicates productivity growth of 5.3% a year, this coefficient, and the model in general, are not well-determined. There is only limited success with the use of the value-added measure of total factor productivity. The graph reveals how poorly the estimate matches the actual changes in value-added, and clearly there should be a better model to describe the dynamics.

An ECM for Gross Output

The integration statistics reported above support a hypothesis regarding a possible long-run relationship between industrial output and the inputs employed in a production function. The Engle and Granger two-step procedure is used to estimate an ECM for gross production in the industrial sector.[48]

Static LR equation:

$$go^* = -5.808 + 0.533\,k^* + 0.674\,l^* + 0.327\,m^* \qquad \text{(IX.10)}$$

$$\qquad (0.85) \quad (0.17) \quad (0.13) \quad (0.13) \qquad \text{(standard error)}$$

Wald test $\chi^2(4) = 113077.7$; D.W. $(res_t) = 1.597$; A.D.F. = 3.551.

The relationship seems to be well determined, as the high value of the Wald test statistic indicates. The value of the CRDW (the Durbin-Watson statistic for the residuals) and the Augmented Dickey-Fuller test for the existence of a unit-root in the residuals suggest that the residuals are

[48]It is clear that the Engle and Granger (1987) procedure suffers from some drawbacks, particularly when compared with the Johansen ML method, but it does have the advantage of being easy to implement, particularly in the context of the very limited degrees of freedom available for modelling gross output as a function of inputs.

stationary, indicating the possible existence of a cointegration vector for the variables above.

Campbell and Perron (1991) point out that the Durbin-Watson statistic provides a useful rule of thumb, but argue that the statistic should not be used as a test of the null hypothesis of no cointegration because of the possible influence of nuisance parameters.[49] However, the very limited number of observations prevent the use of other tests such as those suggested by Phillips and Perron (1988) or the 'Z' tests as developed in Phillips and Ouliaris (1990).[50] In virtually all tests for cointegration, the small sample behaviour is not well known and the tests are sensitive to the presence of a deterministic trend.[51] The graph of the residuals below supports the claim of cointegration.

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[49]See Rule 19 on p. 177 in Campbell and Perron (1991).

[50]Also see Schmidt and Phillips (1992).

[51]See Choi (1992) for evidence regarding the small sample properties of the Durbin-Hausman test. On the general issue of finite sample behaviour of tests for unit roots and cointegration, see Kiviet and Phillips (1992).

Figure IX.iii: Graph of residuals from static long-run equation

Table IX.9: Modelling Δgo_t [RLS estimates 1968-9 to 1987-8]

	Constant	Δk_t	Δl_t	Δm_t	res_{t-1}
Coefficient	0.002	0.526	0.777	0.298	-0.877
t-value	0.09	1.44	3.84	5.46	-3.64

Adjusted R^2 = 0.82; σ = 2.29%; DW = 1.97; Normality χ^2 = 0.34;
AR 1-2 F (2, 13) = 1.38; ARCH 1F (1, 13) = 0.41.

Figure IX.iv: Modelling changes in gross output in industry - Actual and fitted values.

The model displays clearly well-determined parameter values (apart from the coefficient on Δk_t), with "correct" signs, excellent within-sample forecasting performance, and non-critical mis-specification test values.

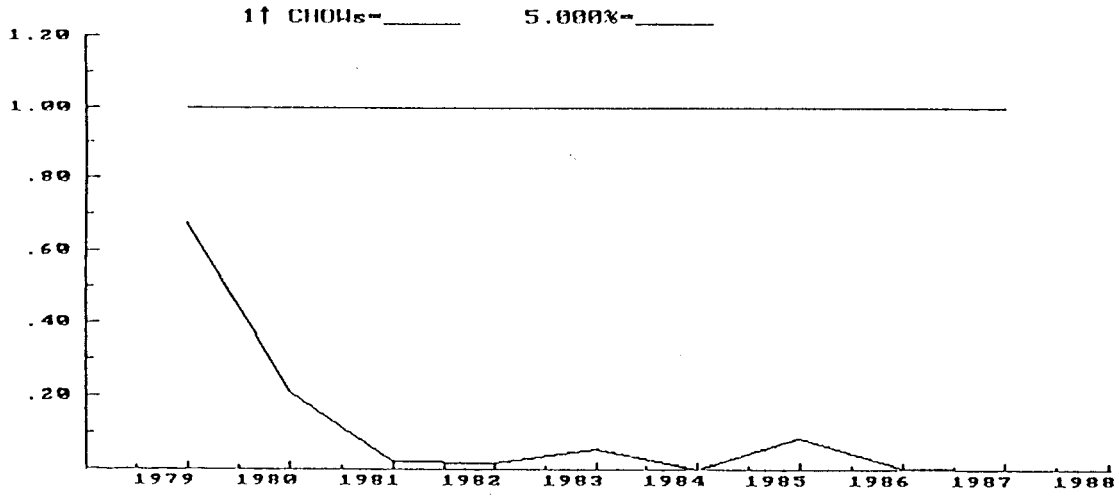

Figure IX.v: Modelling gross output of registered industry - sequence of one-step ahead Chow tests

The residual (EC) term displays the expected equilibrating aspect, is determined in a robust fashion, and is constant when viewed recursively.

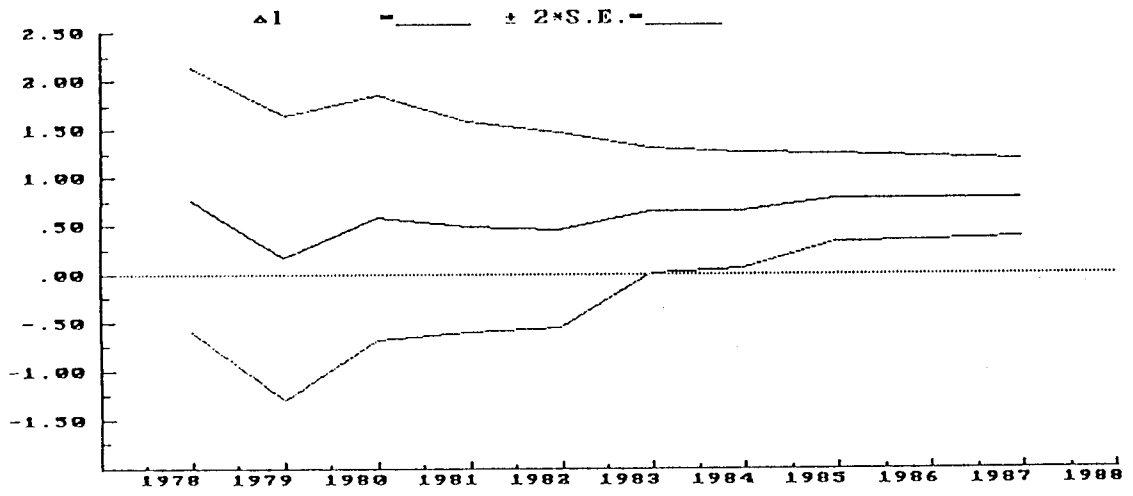

Figure IX.vi: Recursive estimates of the coefficient on labour input.

More interesting is the upward drift in the coefficient on Δl_t in 1982-3, as revealed in the graph for the value of this coefficient, recursively estimated. This rise can be interpreted as either an indication of improved labour productivity, or an increased contribution by labour to the growth in output.

This supply-side model tracks the level of gross output quite well, in contrast to the model for value-added. However, proof of TFPG is difficult to identify. At the same time, there is some evidence of an improvement in labour productivity as indicated by an increase in the value of the coefficient over time.

For registered manufacturing

This section repeats the exercise conducted above, applying it to the context of registered manufacturing. This set of figures may perhaps be considered to more reliable estimates on account of the clearer

correspondence between the units whose capital stock is measured in the NAS estimates and the Factory Sector of the ASI, which was used as the source for the data on output and value-added, labour and raw material input. The time span of the data available for this category is even shorter than that for all industry, which was a major reason for examining the supply-side of the industrial sector as a whole. There is little difference in the model results, and the conclusions that can be drawn based on the industrial sector including electricity, gas and water supply also hold true for the manufacturing sector considered separately.

Table IX.10: Integration statistics: Registered manufacturing[52]

Variable	x_t CRDW	Δx_tCRDW	DF	ADF (1)[53]
k	0.049	1.32	-2.04	-1.86
l	0.115	1.19	-2.67	-2.05
va	0.111	1.88	-2.51	-3.75
go	0.057	1.69	-2.29	-3.16
m	0.157	2.05	-2.81	-3.01

(Number of observations: 16, 1972-3 - 1987-8)

Again, limited degrees of freedom prevented estimation of a translog production function. In any case, the poor results obtained above would

[52]Does not include electricity, gas and water supply.

[53]The calculation of the DF and ADF values is sensitive to the inclusion of a trend; the trend was included in the case of all the variables except l.

suggest that no remarkable success was likely. The results of estimating a straightforward CRS Cobb-Douglas form are represented below:

Table IX.11: Cobb-Douglas production function estimates: Dependent variable - $(va/l)_t$ [RLS estimates 1970-1 to 1987-8]

	Constant	$(k/l)_t$	l_t	Trend
Coefficient	-2.49	0.652	0.097	0.013
t-value	-0.24	0.93	0.10	0.35
Coefficient	-1.499	0.586	-	0.017
t-value	-10.49	3.84	-	3.78

Diagnostics (for the equation without l_t) Adjusted $R^2 = 0.38$; $\sigma = 5.37\%$; DW = 1.45; Normality $\chi^2 = 0.61$; AR 1-2 F (2, 13) = 3.39; ARCH 2F (2, 11) = 0.84.

The results are only marginally better than the corresponding case for all industry, but the value-added estimates once again suffer from overall poor specification and limited explanatory power.

Table IX.12: Modelling Δva_t [RLS estimates 1971-2 to 1987-8]

	Constant	Δk_t	Δl_t	Trend
Coefficient	0.020	0.109	0.379	0.001
t-value	0.33	0.09	0.48	0.24
Coefficient	0.028	0.310	0.271	
t-value	0.57	0.33	0.43	

Diagnostics (for the equation without the trend) Adjusted R^2 = 0.48;

σ = 7.41%; DW = 1.94; Normality χ^2 = 0.47; AR 1-2 F (2, 12) = 1.09;

ARCH 1F (1, 12) = 3.31.

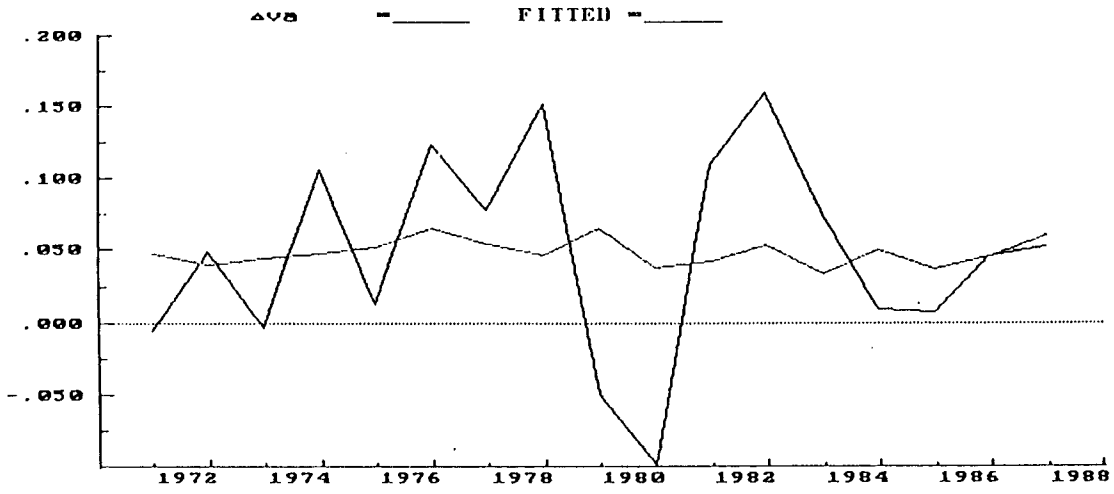

Figure IX.vii: Modelling changes in value-added in registered manufacturing - Actual and fitted values.

The reparametrised version of the value-added equation suggests that productivity growth was of the extent of 2.8% p.a. but the t-value indicates that the coefficient is not significantly different from zero.

Gross output ECM: KLM as explanatory variables

A satisfactory specification is obtained using the gross output method., relying on the ASI Factory Sector figures on gross output, material and labour and net capital stock figures from the CSO.

Registered manufacturing (1971-2 to 1987-8) Static LR equation.

$$go^* = -7.786 + 0.642\,k^* + 0.784\,l^* + 0.320\,m^* \qquad \text{(IX.11)}$$

(0.83) (0.18) (0.11) (0.12) (standard error)

Wald test χ^2 (4) = 361521.2; D.W. (res_t)= 1.756; A.D.F = 5.841.

Table IX.13: Modelling Δgo_t [RLS estimates 1971-2 to 1987-8]

	Constant	Δk_t	Δl_t	Δm_t	res_{t-1}
Coefficient	0.006	0.620	0.679	0.270	-0.934
t-value	0.41	2.12	3.43	5.07	-3.12

Adjusted R^2 = 0.88; σ = 2.29%; DW = 1.92; Normality χ^2 = 0.79;
AR 1-1 F (1, 10) = 0.43; ARCH 1F (1, 9) = 1.07.

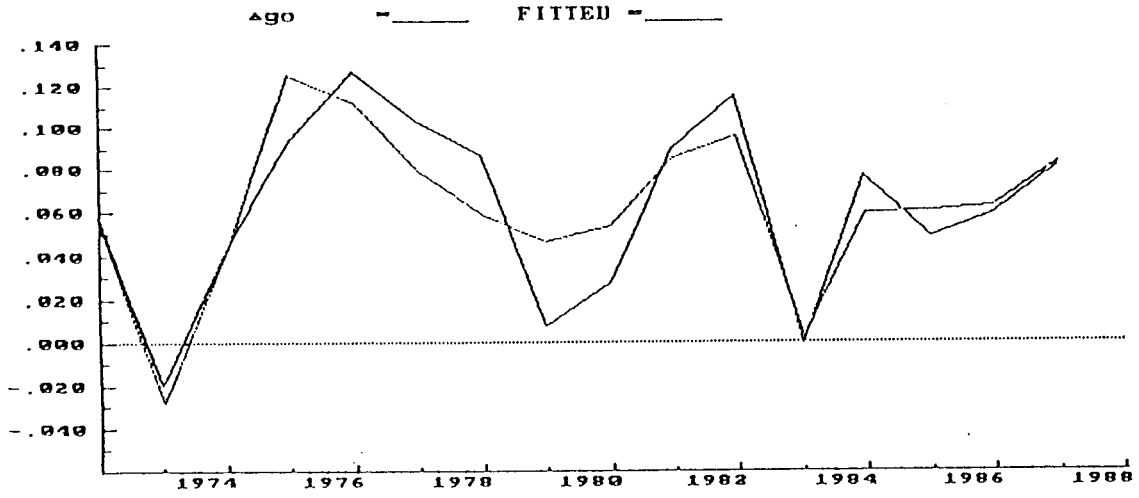

Figure IX.viii: Modelling changes in gross output in registered manufacturing - Actual and fitted values.

The ECM is better determined than in the case of the entire industrial sector, and provides a reasonable explanation of the movement in gross output.

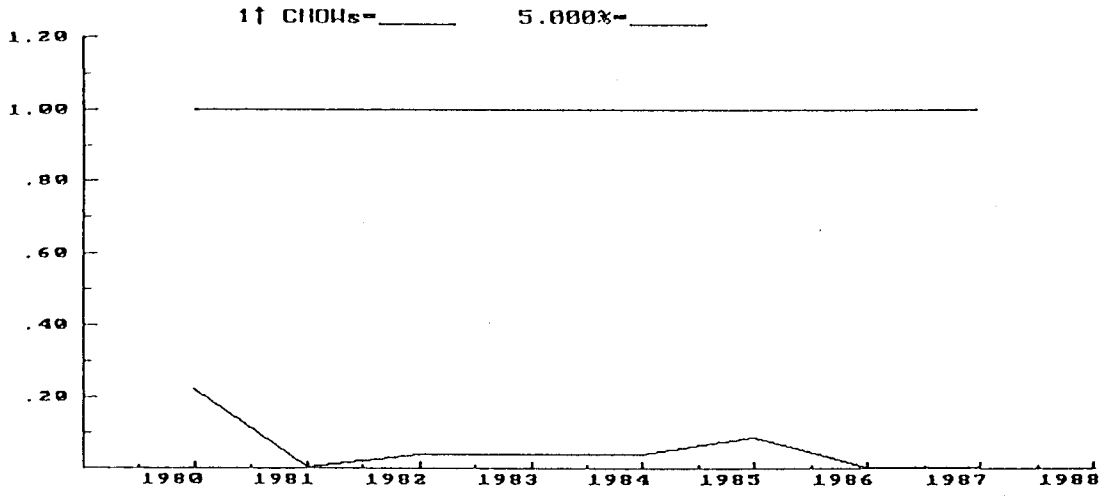

Figure IX. ix: Modelling changes in gross output in registered manufacturing. An indicator of constancy - sequence of one-step ahead Chow tests.

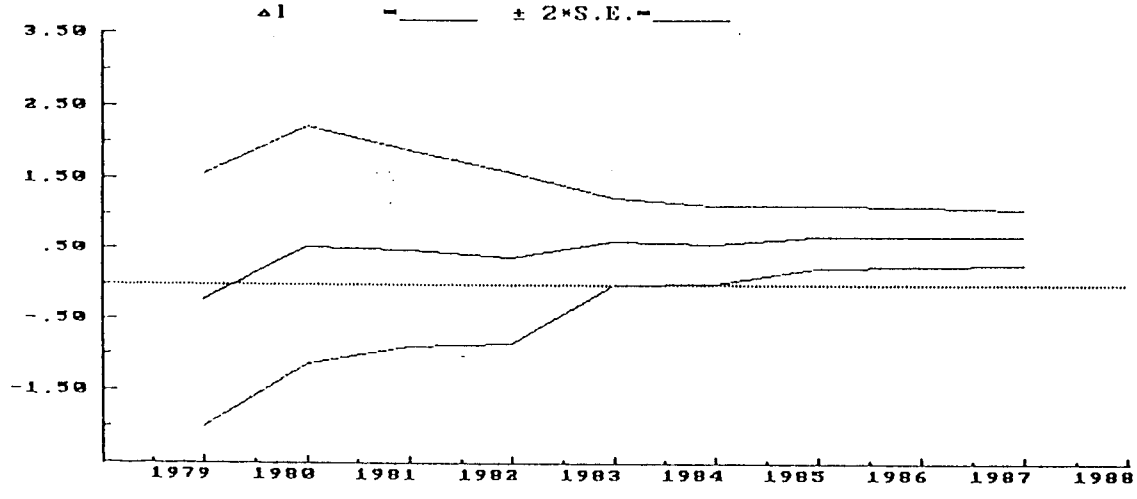

Figure IX. x: Modelling changes in gross output in registered manufacturing. A sign of increasing contribution of labour - a rising coefficient on labour input.

A discussion of the results

Placing the results in the context of the findings of earlier researchers and the agenda presented above, it appears that some of the issues are clearer, and some no nearer being conclusive.

A plausible explanation for the nature of the results on TFPG

With labour input levels relatively stable, and capital stock increasing steadily, it is quite obvious that productivity, conventionally measured, will improve whenever the rate of growth of output increases. The significant question relates to the nature of the change, and the factors responsible for the upsurge in output and productivity respectively, and the manner in which these two variables interact with and influence each other.

Therefore, the role of material inputs in determining the extent of the growth in output becomes important. If L is stable, and K is a relatively stable, if increasing, series, the movement of the relatively noisy output series is likely to find an echo in the fluctuation of another relatively noisy series - material input.[54]

In the context of Indian industry, however, the time-series version of the value-added production function provides a poor description of dynamics. The gross-output production function involving raw material input and not power and electricity is able to describe the evolution of output more

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[54] As in any economy, investment at any time accounts for a very small proportion of the existing capital stock. In addition to this inertia in the level of the capital stock, unless there is a very rapid rate of scrapping and replacement by new vintages, even the quality and composition of the productive stock changes relatively slowly.

faithfully. This suggests not so much that the condition of separability is violated but that the value-added function offers an inadequate method of accounting for changes over time. In that event, basing conclusions about productivity change on such a production function is not sound practice.

A probable explanation for the importance of raw materials in explaining the dynamics of industrial output relies on the fact that it is the only truly variable input in view of the limited ability of firms to adjust the extent of employment. It is quite possible that the use of a more accurate measure of labour input - one that takes account of temporary labour as well as the intensity of labour use - would result in an improved dynamic performance of the value-added production function.

It is worth noting that electricity and energy input was not a significant influence on gross output, either for all industry or manufacturing. Hence, the "KLEM" estimates do not include E.

The limited extent of the change

There is fairly widespread agreement across methodologies and across time-periods that TFPG in industry was minimal, to the extent that such productivity growth had indeed taken place. As reported above, the extent of such estimates is so small that it is very difficult to distinguish them from zero, and this difficulty in precisely estimating an insubstantial quantum is perhaps a reason for the discrepancies between the various estimates.

Even for the period of enhanced growth, estimates of TFPG are quite small, though there is evidence of an upward drift in productivity. Measurement errors have been considered as an important influence on

indices of TFPG, and the order of magnitude of the TFPG estimated could very easily be swamped and completely upset by measurement errors.

The timing[55]

Different breaks in trend in output and productivity

In the initial chapters of this dissertation the turnaround in output growth in industry has been located in 1979-80. Nagaraj (1989) also locates the beginning of the process of acceleration in growth in the same year. However, the turnaround in productivity takes place after 1982-3, as Ahluwalia (1991) contends. Whatever evidence of productivity improvement I find also takes place after the same year. Clearly, the improvement in efficiency followed the increase in the rate of growth of output.

Breaks in trend before policy liberalization - what links?

In order to place the timing of the alleged increase in productivity in context, it is worth reiterating that substantial liberalization of industrial and trade policy takes place only after 1984, at the earliest. The most significant measures of liberalization came into effect only in the second half of the 1980s, and the implementation of these measures was not instantaneous.

When these facts are combined with the Verdoorn Law phenomena that have been documented by both Goldar (1986) and Ahluwalia (1991), it becomes very difficult to sustain the argument that liberalization induced productivity growth, which in turn induced a growth in output.

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[55]Relate to Note on Features of Liberalization.

The nature of causality

The recent renewal of interest in the "growth accounting residual", and explanations for it in terms of increasing returns to scale and "learning by doing", could be invoked if there indeed was a residual to account for. In the framework above, the residual is either non-existent or so small as to be insignificant.

Even if there was an improvement in total factor productivity, what induced the expansion in output in the first instance? While the various supply-side influences can be seen as achieving an increase in output, the rationale for the increased output itself has to be identified. The instigating role of increased demand must be appreciated in this context.

A role for liberalization can be envisioned in terms of allowing output to expand in response to changes in demand. The reform of the policy structure could have played a part by not allowing the impetus provided by the expansion of demand to be eliminated by regulatory restrictions on expansion of capacity. Subsequently, the supply response could have been aided by measures which facilitated the installation of fresh capacity as well as the entry of new firms.

In the next chapter, I attempt to interpret the results obtained from the econometric models of demand and supply and combine the insights gained in the various parts of this investigation.

X

A TENTATIVE EXPLANATION

This chapter attempts to combine the different parts of this thesis and present a unified picture of the process of industrial growth in India. The tentative and necessarily speculative character of the discussion in this chapter needs to be kept in mind in assessing the contents of this interpetation of the process of growth in industry. I attempt to assess the experience of liberalization in the 1980s, and suggest some possibilities for policy reform in the future.

An expository model

The models of demand and supply separately provide a description of the evolution of the industrial economy. The importance of cost terms in the determination of industrial prices, and the persistence of substantial levels of excess capacity in the face of expanding output are features that provide a backdrop for industrial growth. Consumption and investment demand for industrial output do not exhibit parameter shifts or instability; nor does the supply side where a gross output production function adequately describes dynamics. A simple model is presented below to combine these features.

Ideally, the simple model presented below could be estimated to identify the supply and demand functions for the industrial sector and thereby isolate the constraints on growth. However, a consistent set of statistics that provides coverage of both the demand and supply aspects is not available. For instance, estimates of the components of demand are available only at an economy-wide level or at the level of all industry. Figures for the supply-side variables are available only for the Factory

Sector of the ASI, a sub-sector that accounts only for registered manufacturing activity. In addition, the coverage in terms of time-periods is also inconstant.

At the same time, the analyses of the demand, and supply side, in turn, help to isolate the determinants of change over time. The different models of demand and supply are consistent over time, but the differences in coverage of the models prevents the estimation and testing of a simultaneous model that would permit study of the mode of interaction between these aspects. In time, it may be possible to be less circumspect and tentative in reaching a conclusion. Alternatively, the availability of figures at greater frequency for the most recent past may aid in more definitively resolving the issue of the proximate causes of growth.

A digression on excess capacity and its possible causes

The most interesting aspect of capacity utilisation in Indian industry is not the level of excess capacity but the persistence of such excess capacity even in the face of increases in production. Support for the existence of this phenomenon has been supplied in earlier chapters at the industry-wide level as well as in cases of specific industries. Capacity utilisation levels that do not vary substantially in the long-term play an important role in the model below. This importance stems from the ability to expand output in the short-run by increasing the extent of utilisation, combined with the maintenance of certain levels of excess capacity in the long term.

While capacity utilisation has traditionally been considered with respect to the fixed factor of capital or plant and machinery installed, there exists a case for viewing several other inputs such as trained or skilled manpower as being quasi-fixed. There is little reason to doubt that the maintenance of very substantial levels of excess capacity has been a response to the

nature of the regulatory framework and the system of licensing as well as a result of the supply bottlenecks and demand deficiency. Endogenous determinants of the level of capacity use can be distinguished from those that are beyond the control of the firm.

Several interesting hypotheses have been advanced to account for the existence and extent of excess capacity in India, apart from the usual reasons popularised by theorists of industrial organisation and firm behaviour, such as entry deterrence.[1] Bhagwati and Desai (1970) put forward the argument that capacity was increased by firms to pre-empt the entry of new firms or the expansion of existing ones in a scenario in which government regulated the total amount of capacity that was to be allowed in a particular sector. It can also be argued that the continual and repetitive automatic licensing granted to establishments that expanded capacity beyond the allowed limits[2] encouraged firms to expand their installed levels of capacity beyond that warranted by the state of the market at a particular instance in time, generating levels of under-utilised capacity in anticipation of possible future expansion of demand.

Blinder and Maccini (1991) have advanced a theory of inventory behaviour that focuses on a desire by firms to "bunch" rather than "smooth" their production profile. If this kind of behaviour is taken to the extreme, investments in "excess" capacity could be undertaken to allow episodes of high demand to be exploited.[3] In a production situation

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[1]See Fudenberg and Tirole (1984) and Bulow, et al (1985).

[2]"History repeats itself, first as a tragedy, and then as a farce."

[3]Blinder and Maccini (1991) talk of inventory holding to allow production bunching rather than smoothing in the context of inventory based cycles and stock-adjustment principles.

characterised by frequent dislocation, shortage and non-availability of complementary inputs, "excess" capacity can be viewed as a response to allow the fullest exploitation of periods in which availability of inputs was optimal. Viewed over a long enough time horizon, this kind of behaviour would translate into the maintenance of inordinately high levels of excess capacity. In particular, the availability of power is extremely erratic in several parts of India and for several "non-priority" industries. The process of temporal aggregation would conceal the existence of spikes in capital utilisation that result from attempts to make the fullest use of inputs that cannot be stored, and whose supply is variable. However, in the absence of figures on production, input availability and capacity use disaggregated by production unit and at a higher frequency than once a year, such an explanation can only be tentative.

Sahay (1990) attempts to provide an explanation for the persistence of excess capacity that is related to the existence of quotas on imported inputs that are based on installed capacity. The premia on imported inputs create an incentive for manufacturers to install capacity that is greater than can be utilised. In this theoretical discussion, the replacement of such quotas for imported inputs by tariffs on the imported inputs leads to an elimination of excess capacity even in the imperfectly competitive markets. Sahay contends that the usual recommendation for the replacement of quotas by tariffs is further buttressed by this demonstration that the incentive to maintain excess capacity is eliminated.

The maintenance of excess capacity could be viewed as an extreme manifestation of such a phenomenon to allow full utilisation of inputs whenever they happened to become available and to meet sudden surges in demand. This is another tentative hypothesis that requires careful investigation.

By its very nature, the lag between investment decisions and their fruition in terms of eventual production is a process that takes a substantial amount of time. Anticipation of changes in demand patterns and supply responses to such expected alteration in the pattern and structure of demand play a role which, however, is likely to be less than universal. In addition, if a myopic feedback process is the basis of investment decisions, the gap between changes in the state of demand and induced changes in productive capacity would tend to become longer.[4] It is easy to imagine that this phenomenon would be important in India - apart from the usual reasons for delays between investment decisions, the implementation of those decisions and their realisation in terms of enhanced productive capacity, the operation of the licensing system and the so called "permit Raj" would reinforce the tendency for such lags to exist, and perhaps even increase their length.[5] An important aspect of the process of liberalization has been the attempts to reduce the nature of bureaucratic approval necessary for expansion and reduce the extent of the discretionary control over licences and permission of various kinds amenable to political influence. Despite delicensing, "broadbanding" and other measures to introduce some measure of flexibility in determining the nature of the product-mix, there is little reason to believe that the impact in practical terms was at all substantial for any but the last few years of the 1980s.

A necessary qualification needs to be made with regard to the availability of vital intermediate inputs and capital goods, often imported, and the relation of this factor to both the making of decisions regarding

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[4]This myopic process is pretty much the accelerator principle.

[5]Bhagwati and Desai (1970) catalogue the nature of the delays and the likely obstructions to be overcome in the process of creation and expansion of industrial capacity.

investment and the ability to implement such decisions.[6] This is a caveat that would extend to both public investment as well as private capital formation; furthermore, the picture is complicated by the complex relation between public and private investment.[7]

What the models of demand and supply show

The models of demand and supply show that it is possible to view the experience of the 1980s as a continuum in terms of fundamental macroeconomic relationships. The essence of the analysis of the demand and supply influences on the industrial sector discussed in the preceding chapters can be represented as follows:

$$Di_t = d\ (C_t, G_t, I_t, X_t) \qquad (X.1)$$

$$Si_t = s\ (\ (S\text{-}\underline{k}D)_{t\text{-}n}, k_t) \qquad (X.2)$$

$$Pi_t = p\ (\ W_t, RM_t) \qquad (X.3)$$

$$Oi_t = Si_t^* = Di_t^* \qquad (X.4)$$

(D = demand; C = consumption; G = government expenditure; I = investment; X = exports; S = supply; k = index of capacity use; P = price; W = labour cost; RM = raw material cost; O = output. The subscript 'i' denotes that the variable relates to industry.)

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[6]The "industrial recession" of 1991 seems to have been precipitated largely by the cutbacks in government spending and imports in the aftermath of the BOP crisis of that year. This would bear close investigation in the years to come.

[7]In several cases, access to foreign capital is a prerequisite to investment - indicating both the access to finance as well as the approval of a foreign collaborator, both factors that would increase the likelihood of obtaining a licence and decrease the time taken to do so.

The nature of the lags involved is an important aspect - I suggest that output is essentially determined in the short-run by the state of demand. Bearing in mind the existence of excess capacity, this does not seem unreasonable. Also, the fact that demand increases do not place pressure on prices supports a view that emphasises a quantity-adjustment in response to demand changes.

As regards supply conditions, it appears that there is not an instantaneous response to demand changes, but a delayed adjustment. Of course, such lags are inherent in the adjustment of capacity in any context, but seem of particular importance in the heavily regulated industrial economy in India. Material input fluctuation bears the brunt of this adjustment process, with great inertia characterising the quantum of capital and labour input use. The maintenance of levels of excess capacity shifts the burden of short-term adjustment to the only truly variable factor - raw material input. The far greater success of the gross-output production function that included raw material inputs in accounting for the dynamics of industrial production relative to the value-added form provides the underpinning for this view.

In terms of supply, demand changes in the short-run brought about a change in capacity utilisation. In the intermediate and longer term, it is likely that a change in capacity was effected to maintain certain desired levels of excess capacity.

Short-run determination of output by demand

The model involves an asymmetry between the speeds of adjustment of supply and demand in the industrial sector to exogenous shocks. Production in the short-term adjusts to meet changes in the level of demand through variations in the extent of capacity utilisation.

Alterations in the level of demand for industrial products could thus induce an immediate adjustment in the level of output.

The existence of significant levels of excess capacity in Indian industry underpins the argument that short-run adjustment is essentially brought about by changing the intensity of input use and varying the rate of capacity utilisation. Methodological objections can be raised regarding the appropriateness and veracity of the measures of excess capacity, but all that is needed for the argument to succeed is consistency in these measures over time. As long as these measures are comparable over time, the argument presented above is sustainable.

Medium term adjustment of capacity to demand patterns

Given this situation of substantial excess capacity that has shown little tendency to alter greatly over time, it can be argued that supply adjusts to the level of demand. Sustained periods of high demand, or anticipated increases in demand, viewed in relation to some norm, engender a response in terms of adjustment of capacity through investment in fixed capital - usually by existing firms, but possibly by the entry of new agents on the market.[8]

If some excess capacity is desired, and is maintained voluntarily, an increase in demand that is expected to sustain itself will induce an adjustment of capacity in the medium term. The logic that leads to excess capacity also promotes a maintenance of this type of excess capacity. Hence, a sustained increase in demand, whether actual or expected, brings

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[8]As Favero (1990) and Hendry (1990) have demonstrated, there is a theoretical need to distinguish between feedback and feed forward mechanisms, and there exists the empirical possibility of doing so.

about investment in stock to create capacity in order that 'equilibrium' levels of capacity use are maintained. Liberalization of the industrial environment should have as one aim the reduction of these levels of excess capacity. The consequent increase in the efficiency of resource use, which could alternatively be viewed as a reduction in waste, could be an important contribution of the elimination of controls and restrictions on firm behaviour in the future.

The conjuncture of events

As the preceding chapters have shown, a variety of phenomena provided the setting for the process of industrial growth in the 1980s. The beginnings of policy reform and delicensing in the middle of the 1980s may have aided supply responses towards the end of the period under consideration. It is important to note that supply dynamics are adequately accounted for by changes in input use and that productivity enhancement had little role to play in the expansion of output. In this way, productivity shocks had little to do with the increase in industrial growth in the 1980s. If policy reform was able to increase the rate of industrial growth, it was not through accelerating factor productivity growth. As time elapses, and the reforms proceed, and as more data points become available, it may be possible to evaluate the impact of industrial policy changes more fully.

In the absence of structural changes in terms of breaks in the estimated functions of consumption and investment, and given the relatively weak link between exports and domestic industrial production, the burden of accounting for the change in the rate of industrial growth ultimately falls on the exogenous factor of government spending. The key to the expansion was the increase in deficit-financed government expenditure in the 1980s. The contribution of government expenditure was particularly

significant because of the form it took - largely consumption rather than public investment which could well have led to a crowding out of private capital formation and limited the expansion of aggregate demand. A qualification is in order here - public investment does not necessarily have to crowd out private investment. However, the manner in which this public investment was deployed in the 1980s typically led to a reduction in private fixed capital formation.

The fiscal expansion may also have served to stimulate private consumption demand because of the way in which it was financed. The increase in deficit financing can possibly be seen as having influenced the liquidity position of the economy and having increased the wealth of some consumers, or at least the perception of wealth for some. Such an increase in wealth could have influenced the demand for consumption goods and led to an increase in the demand for durables and what would be considered luxuries in India.

The role of agriculture

The importance of costs in the determination of output brings to the fore the relevance of food prices, the prices of the most important wage goods. The maintenance of excess foodstocks, and the heavy reliance on food and fertiliser subsidies[9] to keep the price of food low relative to industrial prices allowed an expansion of the industrial sector without the agricultural constraint binding.[10]

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[9]There was no increase in the price of fertilisers in the decade up to 1991-2.

[10]More correctly, this enabled the entire non-primary component of the economy to expand without coming up against the bounds that higher food prices would have otherwise imposed.

Writing on Indian industry has tended to accord a great deal of importance to the links between agriculture and industry. In most cases, such links assume the conventional incarnations, such as supply of raw materials and inputs/demand for industrial products. This conventional view frequently relies on the connection between agriculture and industry in terms of the relative price between the two sectors. Movements in the terms of trade determine the extent of the impact that one sector exerts on the other. However, movements in the terms of trade can have double-edged effects, and the direction of the impact is best determined empirically rather than theoretically.[11]

More sophisticated analyses operate in terms of the interconnectedness of these supply and demand relationships, but most are concerned more directly with the feedbacks at an economy wide level.[12] For instance, Sen (1981) establishes, using a consistency planning model, that between 1953 and 1976, economic growth was effectively constrained by agriculture, and that, even if more investible resources had been available, the economy could not have sustained a faster rate of expansion.[13] Even in this kind of analysis, agricultural development is important as a potential constraint rather than as a binding one.

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[11]Bhaskar (1990) illustrates the distinction between the 'Mitra' view and the 'Keynes-Kaldor' view, and shows how the two views suggest that terms of trade movements have opposite effects on industrial demand.

[12]As an example, we have from Sen (1981), in the context of the economy as a whole, "The demand problem is an integral aspect of the nature of the supply constraint".

[13]He finds that the actual rate of growth was just under his calculated agriculture-constrained rate of growth, which in turn was lower than the savings- or import-constrained rate of growth.

This corresponds to the conception of the Indian case as an example of a Kaleckian 'agriculture-constrained' economy.[14] An agriculture-constrained economy, by this view, is one in which there exists a maximal rate of agricultural growth that cannot be exceeded by the use of investible resources alone. Accepting that fundamental land reforms are no longer on the agenda in India, this view appears to have some validity, given that the Green Revolution was not able to increase the long-term rate of agricultural growth.

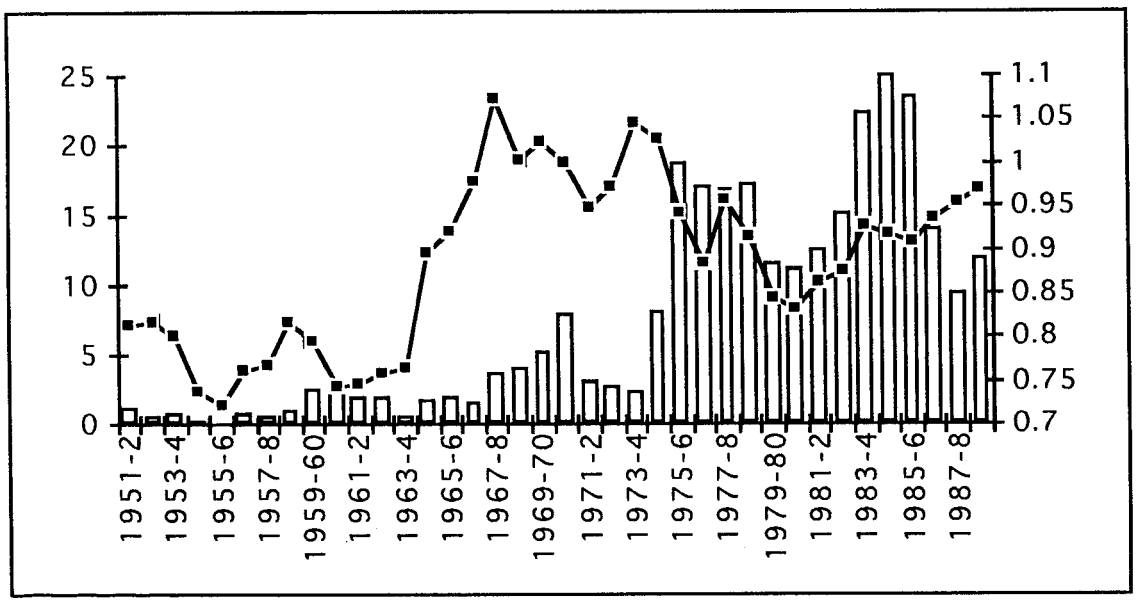

Figure X.i : Foodstocks and relative-price movements.

Columns and left scale: Government foodgrain stocks in m.t.[15]

Line and right scale: Price index of food relative to price index of manufactures (1970-71 =1)

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[14]Kalecki (1970) sets out a model of the dynamics of a mixed economy facing an agricultural constraint. The distinguishing feature of the agricultural constraint is a limit to the maximal rate of agricultural growth that can be achieved without wide ranging institutional reform and structural change.

[15]The level of foodgrain stocks was estimated by cumulating the net addition to foodgrain stocks by the government every year. Figures on addition to government stocks were obtained from the Economic Survey 1991-92.

The food situation altered fundamentally after 1975, as the figure shows. After that year, levels of government foodgrain stocks have been at least 10 million tonnes, which would suggest that the agricultural wage goods constraint ceased to exist. The maintenance of excess foodstocks, and the heavy reliance on food and fertiliser subsidies[16] to keep the price of food low relative to industrial prices allowed an expansion of the industrial sector without the agricultural constraint binding.[17] Even without a change in the trend rate of growth of agriculture, a 'temporary' increase in agricultural production may well have been sufficient to build up anti-inflationary stocks of foodgrains.

While the overall trend rate of agricultural growth remains unaltered by the Green Revolution, regional, crop-wise and inter-farm inequalities appear to have grown.[18] It appears that this process of agrarian growth has bolstered change in industry, even if the form which these changes took is not in itself desirable. The appearance of large "surplus" foodstocks against the backdrop of an unchanged level of per caput production can be reconciled with the existence of a phenomenon of "underconsumption" across regions.[19] While overall food production levels have seen large

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[16]There was no increase in the price of fertilisers in the decade up to 1991-2.

[17]More correctly, this enabled the entire non-primary component of the economy to expand without coming up against the bounds that higher food prices would have otherwise imposed.

[18]See Utsa Patnaik (1986) for a detailed treatment.

[19]Patnaik (1988) develops this argument to expose the perverse nature of 'self-sufficiency' in foodgrains and the emergence of very large grain holdings by the government.

fluctuations, in the Green Revolution areas[20], output as well as the marketed portion of that output have seen a steady climb. In addition to this mechanism that eases the wage goods supply constraint, it is easy to envisage the emergence of a category of rich farmers able to purchase relatively sophisticated consumer goods.

Goldar and Seth (1989) find a positive correlation between the growth rate of agriculture and the extent of industrial deceleration experienced for the states they study. It is possible that, with the demand expansion coming from the tertiary sector, the limited growth of demand from the agricultural sector has not posed the problem to industry that it might otherwise have. The slow expansion of industrial employment, coupled with the emergence of reserve foodgrain stocks, could similarly have prevented the wage goods constraint from binding in the conventional sense.

Recent research by Matsuyama (1991) would suggest that the conventional view perhaps overstated the importance of a productive agriculture in the process of industrialisation. Matsuyama employs a dynamic, perfect foresight model of an economy with two sectors, industry and agriculture, involving overlapping workers. The manufacturing sector is characterised by increasing returns that lead to multiple equilibria. He demonstrates the possibility of an economy trapped in a state of pre-industrialisation or a zero level stationary state, and determines the conditions necessary for industrial development.

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[20]Particularly the states of Punjab, Haryana and parts of Uttar Pradesh. The 'new' agricultural technology appears to be spreading to other regions steadily.

In this model, government action can influence the stationary state that is ultimately achieved, and an economy that would have been stuck in a low level equilibrium can be fundamentally transformed by policy intervention. Matsuyama also demonstrates the counter-intuitive result that a more productive agriculture could hold back industrialisation, and conversely, a less productive agriculture was not likely to constrain development. This result relies on increasing returns in the manufacturing sector which enables sustained growth. However, Matsuyama makes a mistake by using India as an example of an economy that was restrained by a productive agricultural sector.[21] If anything, the model demonstrates the potential for growth that exists in the low level of agricultural productivity in India.

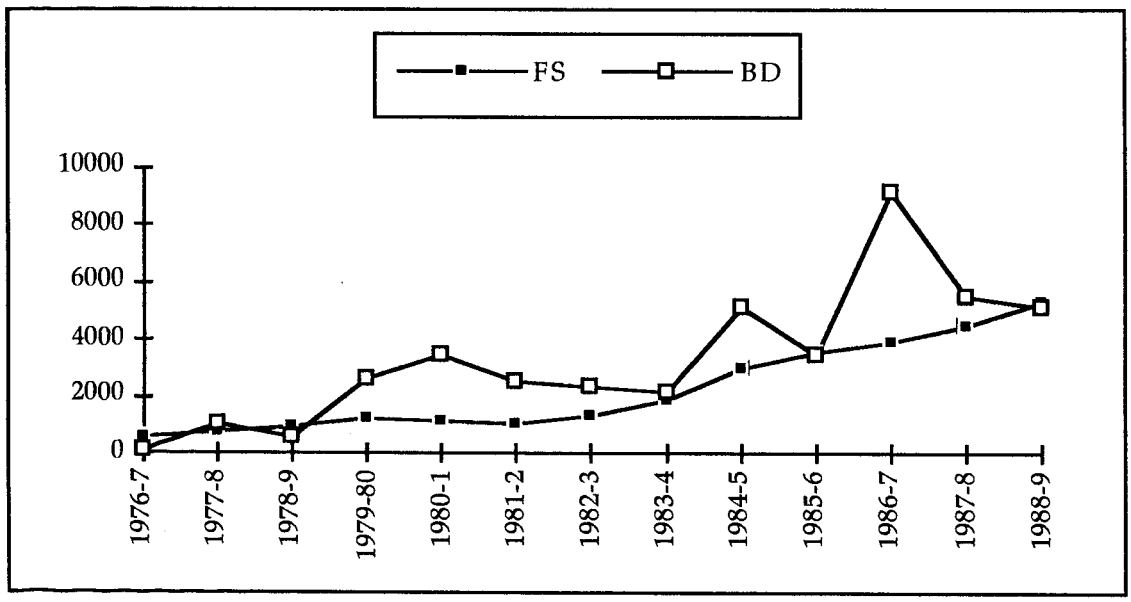

Figure X. ii: Fertiliser and food subsidies (FS) in comparison to the overall budget deficit (BD) (in Rs. crore, current prices). Source: Economic Survey, various issues.

[21]Matsuyama (1991) p. 643.

Even if it appears that industrial growth and overall development could proceed without any necessity for fundamental land reform, there remains a political imperative for land reform, and perhaps a fiscal one also. The growth of food and fertiliser subsidies in the 1980s can be seen as having played a major part in the fiscal crisis that forced a reversal of the policies that promoted growth.

The case for land reform relies on more than just an egalitarian concern in view of the large proportion of the population which draws life from agriculture. The rest of the economy cannot grow fast enough to draw in these agriculturists for the dependency ratio to be greatly affected in any but the very distant future.

The contribution of the tertiary sector

As in virtually all other parts of the world, the fastest growing, and largest, sector in the economy is not the secondary sector but the services sector. The expansion of the services sector has received little attention, and the dimensions and nature of the change are not particularly well known. As would be expected in a dual economy, the tertiary sector has expanded through a proliferation of both low-paid occupations as well as sophisticated services characteristic of developed nations. The low paid jobs serve to absorb those who move out of the primary sector and are not able to find one of the limited number of jobs available in the secondary sector. The growth of the services sector has been traced to the expansion of the public sector and the increase in public sector employment, but other factors are also important. For one, a large number of services support the goods producing sectors - banking and finance, research, development and design, marketing and distribution - and an increase in the goods-producing sector necessitates a proportionately greater

expansion of the service industries that are necessary to make the products more sophisticated.[22]

Kumar (1988) suggests that the services sector is characterised by higher proportions of property incomes than the goods-producing sectors.[23] As a result, the expansion of the services sector is likely to stimulate demand for the rest of the economy, and the development of this sector correspondingly reduces the importance of the agricultural sector as a source of demand.

The experience of the early 1990s

The experience of the early 1990s supplies a validation of the ideas developed in this thesis. In 1991-92 industrial production collapsed, and the growth that had been experienced by the Indian economy in the previous decade was reversed. Cutbacks in government spending, and a consequent reduction in the fiscal deficit, and a squeeze in imports were two prominent features of this episode. The primary impact of these changes can be reckoned to have been felt, respectively, by the demand, and the supply side. In addition, the cutback in imports is likely to have had an impact on investment demand, as suggested by the analysis in Chapter VII.

The significance of the expansionary fiscal policies and the importance of imports were both clearly illustrated by the "sustained corrective action"

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[22]Reich (1992) argues that the division between industry and services is increasingly meaningless.

[23]Kumar (1988) is also of the opinion that the services sector has a higher proportion of unreported to reported incomes.

initiated in the Budget for 1991-92.[24] The crisis in the balance of payments and the "sharp deterioration in the fiscal deficit" necessitated a reduction in fiscal activity and severe curbs on imports.[25] These measures are likely to have contributed to the steep fall in the rate of overall growth and the sharp contraction in industrial output and investment that resulted in the following year.

The increase in internal and external indebtedness that provided an impetus to growth in the 1980s could not be sustained beyond the end of that decade. This episode of enhanced, but ultimately unsustainable, growth furnishes further support for the contention that macroeconomic stability is conducive to economic growth. Fischer (1993) cites the examples of countries ("exceptions") where the growth process was halted by the unsustainability of the fiscal deficits that were an important feature that enabled the growth in the first place.[26]

Liberalization in the 1980s

Industrial and trade policies are only a subset of the policies affecting industry and long-run growth. "The lost decade" of near zero growth in developing countries as a group and the events in Eastern Europe at the

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[24]Economic Survey (1991-92) p. 2.

[25]Foreign exchange reserves in the middle of 1991 declined to a level equivalent to less than 10 weeks worth of imports, and precipitated a drastic downgrading of India's creditworthiness in international capital markets.

[26]Fischer (1993) mentions that the exceptions (Brazil, Israel, Peru, Argentina) among the 80 countries included in the World Bank data set where high growth took place inspite of high inflation and/or large deficits suggest that, "the statement that macro-stability is necessary for sustained growth is too strong, but ... the statement that macroeconomic stability is conducive to sustained growth remains accurate". (p. 3)

end of the 1980s, focused attention on the importance of policy in affecting economic growth.[27]

At the same time, it is clear that it is not just economic policies that matter in determining the extent of growth actually achieved.[28] An evaluation of policy change is a difficult exercise due to the difficulty of identifying the impact precisely of that shift in a dynamic, changing environment. However, even critics of the liberalization carried out in the 1980s admit that it facilitated the expansion in industry, even if it did not actually initiate it.[29]

The "new international economics" suggests that liberalization is likely to yield benefits in terms of enhanced and rationalised scales of production which would, in turn, reduce costs and increase competitiveness in the world market.[30] It is also argued that removing price distortions in the Indian context which arise from tariff protection and the cascading nature of the indirect tax system, and bringing domestic prices closer in line with world prices would force domestic producers to become more efficient, ultimately resulting in an enhanced rate of growth.

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[27]Easterly, et al (1992) provide an overview of the literature on policies and their impact on long run growth. Tirole (1991) deals with the creation of appropriate incentive structures and privatisation in East Europe.

[28]See Easterly and Rebelo (1993) and Fischer (1991).

[29]Chandrashekhar (1988), for instance, uses the term "lubricated" to describe the effect of liberalisation.

[30]For example, see Shoven and Whalley (1984), Srinivasan and Whalley (1987), Rivera-Batiz and Romer (1991) and Grossman and Helpman (1991 a, b). Some of the results of the new trade theory suggest, though, that increased openness to trade may inhibit growth. For instance, see Krugman (1988).

Few attempts have been made to model the impact of liberalization explicitly and demonstrate the likely effects in the Indian context. A notable exception is the study by Lucas using a computable general equilibrium framework to conduct counterfactual simulations to ascertain the effect of liberalization on the manufacturing sector in the sixties and the seventies.[31] The case for liberalization of the firm's environment and financial deregulation relies not just on arguments based on the realisation of potential economies of scale, but also the prospect of large scale redeployment and reallocation of capital over a relatively lengthy span of time. Lucas contended that a reduction in output, albeit a small one, was likely to follow any attempt that consisted exclusively of a reorientation of commercial policy to bring parity between domestic and world prices while ignoring other kinds of constraints on investment and firm behaviour.

The Lucas exercise is significant in that it focused attention on the details of liberalization and the various measures that it entails, and specified the grounds for meaningful discussion. The issue should not be seen as one of liberalization versus no liberalization, but as one of a certain type of liberalization versus another, and of the need for internal consistency in state action as well as coherence with the characteristics of the Indian economy.

Liberalization in the 1980s introduced an element of rationality into the conduct of policy and increased the scope for managerial action and discretion. Delicensing expanded the room for private action, sometimes

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[31]Lucas (1989). The model is described as "not truly one of general equilibrium but focus(ing) largely on endogenous interactions within the manufacturing sector alone".

into areas hitherto reserved for the public sector. It sought to increase competition domestically by lowering barriers to the entry and exit of firms, and raising the limits on the expansion of firms, as well as by lowering tariff and non-tariff barriers to international competition.

However, the scope for further rationalisation is considerable even after the most recent changes announced in the Budget for 1993-4. That the changes in industrial policy in the 1980s were insufficient in scope and extent has been recognised even by the government in its publications.[32] The reforms announced in 1991 are now perceived as constituting the decisive break from previous policies. However, as the 1993 discussion paper on the reforms published by the Ministry of Finance reveals, the government is clearly aware of the need for the continuance of change in policy and structural reform.[33]

Criticism of the liberalization exercise in the 1980s focused on its limitations in a wider context and on apparent contradictions between various facets of this exercise.[34] There is some substance in the contention that attempts at internal liberalization were based on a view of competition that confused competition with numbers of firms rather than the nature of market power and the modes of interaction between firms. In several cases, the small internal market was divided among a number

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[32]See, for instance, the Economic Survey of 1991-92, Chs. 5 and 6 for an assessment of "reforms" in the trade and industrial sectors.

[33]GOI, Ministry of Finance (1993).

[34]A detailed critique of liberalization in the 1980s can be had from Patnaik (1986) and Chandra (1986). More recent developments are analysed in Kelkar and Kumar (1990), who also suggested an agenda for policy reform.

of firms in a manner that militated against optimal size of plant.[35] Obstacles to entry became easier to surmount, though barriers to exit continue to restrain overall efficiency and productivity.[36]

In the last years of the 1980s doubts were expressed about the ability of the government to sustain the liberalization of policy, and the balance of payments crisis in 1991 precipitated a variety of remedial measures. In 1993, it seems that the government can simply not afford not to continue with deregulation and all it entails. There clearly is a continuing role for policy and government intervention, and a need to design measures not just to rationalise the regulatory framework but the overall set of national economic policies.

The increase in dynamism in the 1980s took place with the fetters of regulation essentially still in place. The process of deregulation has only properly begun in this last decade of the century, and the experience of more rapid progress in the eighties is an indicator of the potential that exists for further development.

While the links of liberalization to industrial growth are tenuous for the 1980s, it is clear that liberalization must continue, in a far more widespread and pervasive manner than it has so far. The rationale for espousing deregulation and encouraging a more effective removal of restrictions and barriers to entry and exit does not emerge from the

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[35]The introduction of "Minimum Efficient Scales" of production in the late 1980s for a few sectors went some way in addressing this issue.

[36]Parallels with the "paternalism" of the state in the erstwhile socialist economies are numerous. The term is due to Kornai (1980). Similarly, the 'soft budgets" that public sector units faced allowed them to build up losses and perpetuate inefficiencies.

improved growth experience of the 1980s. Growth in the 1980s took place inspite of the continued existence of regulatory controls. However, the removal of these restrictions is an imperative for growth in the future.

Policy recommendations

Despite the increase in growth, the Indian economy grew just over half as fast as the eight rapidly developing economies of East Asia in the 1980s.[37] The success of China in raising her growth rate in the early 1990s to one which doubled her GDP in seven years is reminiscent of the then unprecedented success of the Japanese economy in the 1960s, and caps a growth performance in the 1980s that was substantially better than that of India. This superior performance of the East Asian economies provides a useful yardstick to judge the Indian growth performance, besides offering a basis for policy recommendation.[38]

The mushrooming of the research on the "new growth literature", the revival of interest in development, and attempts to set these ideas on a firm empirical footing in recent years comprise another source of ideas for the redesign and reform of policies to engender greater increases in the quantity and quality of industrial output in India. The ideas researched and developed in earlier chapters of this thesis embody a third source for suggestions to aid industrial development. The suggestions for policy reform that derive from these different sources are best presented in combination rather than separately in view of their great similarity and the reinforcement that they supply to each other. It is worth tempering

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[37]These countries are Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, Taiwan and Thailand.

[38]Page, et al (1993) provides a detailed account of the "East Asian Miracle".

these recommendations with the caveat that the Government of India is acutely aware of the importance of most of what I suggest, as the discussion paper on the reforms published in 1993 shows only too clearly.

The integration of short-run macroeconomics with long-run growth has not proved to be an easy task, and this thesis should be ample illustration of the difficulty of uniting the two major concerns of macroeconomists.[39] The 'new' theories of growth and the renewed emphasis on national policies as factors influencing growth appear to have great promise in identifying avenues for state action in affecting the short-run macroeconomy as well as influencing growth. The scope for government influence is likely to be constrained by the history of development, both in the narrow sense of the immediate past in macroeconomic terms, and in the broader sense of the political and social context in which policy decisions must be made.

[39]Solow (1988) points out the need for research to integrate the two aspects. On the same subject, see Stiglitz (1990), Arida and Taylor (1989) and Orphanides and Solow (1990).

Table X.1 : Gross domestic saving and fixed capital formation (% of GDP at market prices)

Year	Gross domestic saving	Gross fixed capital formation	Private gross fixed capital formation
1950-1	10.4	9.3	6.9
1960-1	12.7	13.3	6.8
1970-1	15.7	14.6	9.1
1980-1	21.2	19.3	10.7
1985-6	19.7	20.7	10.2
1988-9	21.1	21.1	11.1

Source: Economic Survey, 1991-92.

The increase in the savings and investment ratios to more than a fifth of GDP in the 1980s provides a backdrop for possible action to increase the rapidity of economic progress. The consensus suggests that increased rates of investment, particularly private investment, are closely related to increased growth, and the Indian experience provides some support for such a view, even if the connection is not completely transparent.[40] At the same time, an emphasis on productivity improvement should accompany any measures to raise the rate of investment.

A reduction of excess capacity would provide at least a one-step increase in productivity and industrial output. An increase in capacity use brought

[40]Easterly, et al (1992) Table 1, p. 1 shows the disparity in average investment rates between fast and slow growing economies. The average level of the private sector investment ratio in the 1980s for the East Asian countries was nearly double that observed in India.

about by the elimination of the underlying causes may also result in an increase in flexibility on part of producers and attenuate the responsiveness of producers to changes in the domestic and international environments.

The outward orientation of the East Asian countries is viewed as a key element in accounting for the continuing success of these nations inspite of the recession in the OECD countries in the 1990s. To some extent, this outward orientation can be viewed as a response to the lack of importance of natural resources in the East Asian process of development - first in Japan, and then in the rest of East Asia.[41] The importance of a clear link between domestic production and export is virtually taken for granted in terms of the encouragement it provides to improvements in productivity. The Indian experience has demonstrated that "export pessimism" is ultimately self-fulfilling. Success in the highly competitive international markets requires not just an outward orientation, but carefully focused programs of product development and market targeting. The moves to an outward orientation begun haltingly in the second half of the 1980s need to be pursued to their conclusion and go beyond merely reversing the earlier disincentives for export production.

In India, the impact of the external sector seems not to have been particularly decisive in the 1980s, but needs to, and perhaps will play a more fundamental role in the future. Improved industrial performance will both help and be helped by better export performance, and the steps already taken, and those yet only envisaged to reduce the extent of

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[41] In particular, Bhattacharya and Linn (1988) highlight this aspect of the East Asian success. Ohmae (1990) actually goes as far as suggesting that an abundance of natural resources actually hinders the process of development.

protection are likely to have a beneficial impact on the competitiveness of the industrial sector.

Commitment to an outward orientation offers an avenue of rectifying some of the macroeconomic distortions that hinder industrial development. An outward orientation does not necessarily imply a removal of all forms of protection, as the experience of the East Asian nations demonstrates.[42] Ultimately, exposing domestic producers to at least the potential risk of foreign competition offers a method of encouraging improvements in productivity, quality, and competitiveness internationally. In India, the still very high levels of the tariffs that have replaced quotas need to be reduced in a phased manner.[43] The changes in exchange-rate policy implemented in the 1990s by floating the rupee on current account mark a major break from the past and it is only a matter of time that full convertibility is established.

The importance of education in the process of development has been stressed by writers of a variety of political persuasions. Bagchi (1982) views education as a (neglected) universal feature of development, while the analysis of Lucas (1988) accords paramount importance to "human capital"

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[42]Much of the conflict between the US and Japan stems from perceptions of protectionism and problems of market access. See Bergsten and Noland (1993).

[43]The Chelliah Committee Report (1993) calculated the average import-weighted tariff rate to be 87% in 1989-90, and recommended that time-bound targets be set for a reduction in this average rate. Corresponding effective rates of protection for the East Asian economies in the mid-1980s, though high, were not greater than 50%. See Page, et al (1993).

in development.[44] There seem to be two aspects - universal basic education and the training of "symbolic analysts" to make the economy, and industry, more productive.[45] The limited extent of even basic literacy in India identifies it as the area that needs most attention and resources. The East Asian nations all targeted primary and secondary education, and by the 1980s, had near universal basic education.[46] As with so much else in India, the system of higher education is excellent for the few privileged enough to have access to it. The training of the symbolic analysts also needs to be better utilised in raising productivity and growth, in some cases by keeping them in or bringing them back to India, through inducement rather than restrictions.

The East Asian industrial success required the structure of industry to alter and evolve in line with the changing requirements of markets and technologies. The changes in the system of industrial licensing achieved largely through the elimination of the need for licensing in all but specific contexts in 1991 have been a major element of the restructuring of industrial policy in India. However, the restructuring needs to embrace positive as well as negative aspects.

Along with the need for an "exit policy" - a demonstration of the ability to allow business failure - the government needs to ensure the retraining

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[44]Once again , Table 1 on p. 1 of Easterly, et al (1992) provides a summary indication of the importance of education in growth.

[45]The term "symbolic analyst" is due to Reich (1992) who identifies the contribution of such persons in a modern economy.

[46]See Page, et al (1993) and Bhattacharya and Linn (1988). Barro and Lee (1993) supply a detailed international comparison of educational attainment.

and redeployment of workers put out of work by structural changes in the industrial sphere. Such a process of redeployment, pursued with particular success during the process of high growth in Japan, would not only prevent the wastage of precious skills accumulated by the process of learning by doing but reduce the extent of opposition of organised labour to the closure of unviable industrial units. Linking employment policies and labour legislation with restructuring could possibly reverse the decline in permanent industrial employment experienced in the 1980s, in addition to aiding the reorientation of production to changing priorities.

Reform does not only imply decontrol and deregulation but requires the establishment of appropriate rules and institutional arrangements to ensure the enforcement of such rules. The financial scandal centred around Harshad Mehta served to highlight the desperate need for financial sector reform. The growing importance of direct finance that facilitated the emergence in the 1980s of large companies like Reliance Industries requires the establishment of an adequate regulatory mechanism and institutional arrangements that prevent potentially destabilising speculative phenomena from emerging. The establishment of a properly functioning capital market would enable the transition from a system of credit allocation on the basis of administrative fiat to one that contains an evaluation of potential returns weighted by the associated risks, as in financial markets in much of the rest of the world. In this way, financial reform could ensure a meaningful evaluation of risk and return by lending institutions, and an erosion of the ability of government to control the direction of investment. Rather than an allocation of funds at a rate of interest determined by government bodies, the financial system would be in a position to ensure that borrowers were made responsible for ensuring that an adequate return was obtained.

Establishing the importance of interest rates for the determination of investment is of particular relevance in the context of public sector production units. A move to raising funds on a commercial basis would reduce the need for the government to allocate revenues to finance the establishment and continued operation of the "commanding heights" of the economy. Withdrawal from the commanding heights would enable the government to concentrate on avenues of public investment that encouraged rather than crowded out private capital formation.

Such a change in the nature of public investment through a focus on the provision of infrastructure, and the removal of bottlenecks such as energy supply are likely to reverse, and at least reduce the extent of the crowding out of private investment observed in the period to 1990.[47] As mentioned in Chapter VII on investment, the nature of public investment is a key to the phenomenon of crowding out, as the contrary experience of South Korea has borne out. Easterly and Rebelo (1993) find public investment in transport and communication consistently correlated with growth but not with private investment, suggesting that expenditure on infrastructure raised the return on private investment. This study based on the Summers and Heston (1991) data set for over eighty countries for the period 1970-88 also finds evidence that public enterprise investment crowds out private investment.

Macroeconomic policy AND industrial policy

Discussion of industrial policy is incomplete without reference to the set of macroeconomic policies that supply the framework in which industrial

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[47]Energy and power as bottlenecks, and possibly contributing to the persistent high levels of excess capacity.

policy has to perform. Changes in both sets of policies need to be reinforcing - the East Asian nations provide an outstanding example of the manner in which these policies interact and influence each other.[48] Reform and restructuring in industrial policy is needed both to facilitate and reinforce changes in the macro-environment.

The connection between capacity use and import licensing connection supplies an example of such reinforcement. The model in Sahay (1990) suggests that the replacement of import quotas by tariffs would remove the incentive to maintain excess capacity. Floating the rupee and eliminating the premia associated with an overvalued official exchange rate is also likely to reduce the tendency to maintain excess capacity to realise import premia. The experience of the next few years will allow the validity of such an hypothesis to be examined more fully, now that import licensing has been discontinued, and the rupee made convertible on trade account.

Debate about the efficacy of industrial policy in raising growth rates continues all over the world, perhaps because the very nature of the debate makes it impossible to resolve empirically. Even in the context of Japanese industry, the role of MITI (Ministry of International Trade and Industry) in forcing the pace of industrial development has been evaluated in many different ways. An extreme position is due to Tyson (1992) who seeks to use the Japanese experience as a basis for recommending an actively interventionist role for US industrial policy primarily to counter the advantage provided to Japanese industry by the policies of MITI. On the other hand, Ohmae (1990) represents the view

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[48]Bhattacharya and Linn (1988) provide several examples of such mutual reinforcement.

which contends that Japanese manufacturers would have been successful even without the assistance of MITI. The middle ground is occupied by the position of Yamamura (1986) who suggests that MITI was effective "because it intervened to affect resource allocations and the pace of investment in advanced technology without attempting to counter the dictates of market forces".[49] The recent assessment of the East Asian experience by the World Bank suggests that some policies - export promotion and direction of concessional credit - were effective in promoting growth, while the promotion of specific sectors had its share of failures.[50] However, a consensus exists on the importance of stable macro-economic policies and the removal of price distortions in setting the stage for increased growth.[51]

A salutary note of caution should accompany this call for change in policy, both macroeconomic and industrial. The finding that much of the variation in national growth rates is related to random shocks should induce caution in attributing high growth rates to country characteristics such as 'good policies' or a 'work ethic' which display far less changeability than rates of growth from decade to decade.[52]

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[49]Yamamura (1986) p. 202. Also see Komiya, et al (1988), Okimoto (1989), and Johnson, et al (1990) for different perspectives on Japan's industrial policy and the role of MITI.

[50]See Page, et al (1993).

[51]Page, et al (1993) and Bhattacharya and Linn (1988) emphasise this aspect of policy. Additional support for this position is provided by the empirical study of Fischer (1993) that covers a far larger geographical area.

[52]Easterly, et al (1992) in their paper with the suggestive title, "Good Policy or Good Luck?", find that shocks, especially trade shocks explain as much of the variance in decadal growth rates as do country policies.

The disparate tendencies in industrial policy in Japan and the US embody a significant trend that can be witnessed the world over - encouragement to public debate in deciding the course of government direction of the economy. This tendency toward *glasnost* or openness in government, common to different political systems and cutting across nations and areas, is one that finds reflection in the increasing importance of public discussion in the formulation of policy in India. Hopefully, decisions based on such discussion and debate will contribute to improved industrial performance and thereby to better conditions of life for Indians in the next century.

XI

A SUMMARY

In Chapter II, I introduced the issue of industrial growth in India considered in this thesis. I demonstrated that there had been an increase in the rate of growth in the 1980s and outlined the context of liberalization in policy in which this increase in growth had occurred.

Chapter III outlined the advantages of the modelling methodology I used, and I discussed such features of time series macro-econometrics as aggregation, unit-roots, cointegration, general-to-specific data-based modelling, and Single Equation Error Correction Models - their theoretical rationale and empirical adaptability. The considerable previous success of this methodology was also noted.

A preliminary approach to the modelling of demand for industrial products was provided in Chapter IV. This demand was decomposed into that arising from consumption, investment, government spending and exports. The increase in levels of deficit financing witnessed in the 1980s provided a background to a description of trends in government consumption and public investment.

To establish the preconditions for modelling demand, I demonstrated in Chapter V that industrial prices were dependent on input cost, and varied contracyclically in relation to industrial activity.

The consumption function developed in Chapter VI provided the basis for modelling consumption demand for industrial output. As in the case of every model developed in this dissertation, I used recursive methods to demonstrate that these models are well-determined and stable over the entire span of forty years studied. This stability over a period that

encompasses the period of acceleration in industry and the shift to a higher growth path for the industrial sector as well as the entire economy attests to the soundness of the models.

The relationship between public investment and private capital formation was analysed in Chapter VII as a precursor to modelling demand for industry arising from private equipment investment. I demonstrated that public investment in the form of machinery and equipment crowded out private equipment investment. The model of private equipment investment attested the importance of private corporate savings, the price of capital goods and imports of machinery in determining private equipment investment. As in the case of consumption demand for industrial output, investment demand does not appear to be influenced by the interest rate.

In Chapter VIII, I suggested that manufactured exports were not a significant influence on domestic industrial performance. I drew attention to the increasing import-intensity of export production and the limited growth of manufactured exports in relation to industrial performance in the 1980s. I pointed out that a large part of the increase in manufactured exports experienced in the 1980s could be traced to commodity groups that were not of central importance to the performance of the domestic industrial economy.

I investigated the supply-side of industry in Chapter IX, and noted that full-time employment in registered industry had declined in the 1980s. Productivity and growth in industry were scrutinised in a framework that combined features of the Solow growth-accounting approach and the 'new' growth theories and incorporated recent developments time-series econometric modelling.

I demonstrated that the acceleration in output growth in Indian industry was followed by an increase in productivity. This procyclical movement in productivity experienced after 1982-3 followed the acceleration in output growth initiated in 1979-80. As significant measures of liberalization in industrial and trade policy were introduced only in the second half of the 1980s, I questioned the contention that relaxation of regulatory control induced improvements in productivity which, in turn, initiated an acceleration in the growth of industrial output.

In Chapter X, I speculated that industry in India was characterised by short-run output responses in the presence of excess capacity that was maintained at relatively constant levels by a medium-term adjustment of installed capacity. I also suggested that the relation between the agricultural sector and the industrial sector had altered significantly by the beginning of the 1980s, and that the services sector was likely to play a more important role in affecting the industrial economy in the future.

I believe that the acceleration of industrial output and the shift of the national economy to a new growth path in the 1980s was achieved in the continued presence of regulatory constraints and restrictions on activity. It is my opinion that the elimination of such controls, properly undertaken in the 1990s, along the lines suggested by the experience of successful industrialisation and development in a number of East Asian economies, and the new growth literature, will bear fruit in the future. It is my hope that the revolution in attitude and metamorphosis of policy will encourage a fundamental transformation in Indian economic life.

APPENDIX

I. SOURCES OF DATA AND DEFINITIONS

Letters in lower case represent logs. Δ represents differences.

ASI refers to the Annual Survey of Industries; NAS refers to the National Accounts Statistics published by the Central Statistical Organisation of the Government of India; TPG refers to The Indian Economy Database compiled by H.L. Chandhok and The Policy Group (1990) and published by Thompson Press on behalf of Living Media (India) Ltd.

As no figures were published for 1972 by the ASI, these were imputed by a simple average of the figures for 1971 and 1973.

P — WPI (1970-1 = 100) for industrial products from TPG.

W — Labour cost per unit output. Ratio of index of per capita earnings derived from ASI to index of product per worker using Index of Industrial Production (1980-81 = 100) from TPG and employment figures from ASI. Derived as in Balakrishnan (1991), using the new IIP rather than the old IIP (1970-1 = 100).

M — WPI for industrial raw materials (1970-1 = 100) from TPG.

D — Ratio to 5-year moving average of the Index of Industrial Production (1980-1 = 100) from TPG.

C — Private final consumption expenditure at 1980-1 prices from NAS.

ICI — Implicit index (1980-81 = 100) of

gross capital formation derived from NAS.

S	Household saving from NAS deflated by ICI.
Y_d	(= C + S). Disposable income at 1980-1 prices.
D	(= Time deposits + Demand Deposits). From IMF International Financial Statistics. The reclassification between time and demand deposits in 1978-9 has no impact on the aggregate.
P_f	WPI for food articles from TPG (1970-1 = 100). Rescaled to make 1980-1 = 100.
P_m	WPI for manufacturing from TPG (1970-1 = 100). Rescaled to make 1980-1 = 100.
SR	(= GDP in primary sector / Total GDP). At 1980-1 prices from NAS.
P	CPI from TPG (1970-1 = 100). Rescaled to make 1980-1 = 100.
R	Interest rate on 1 year bank deposits. From RBI Report on Currency and Finance, various issues. In the case of investment, the State Bank advance rate from TPG was also used.
CI	Consumption of industrial products. Sum of expenditure at 1980-1 prices from NAS on: Food (excluding cereals and pulses) + beverages + tobacco Clothing and footwear Furniture, etc.

Personal transport equipment

Miscellaneous goods and services

CRED — Change in scheduled commercial bank credit from RBI Report on Currency and Finance, scaled by ICI.

MME — Imports of machinery and transport equipment from TPG and Economic Survey, various issues. Deflated by the implicit price index for total gross fixed capital formation in machinery and equipment (1980-1 = 100) from NAS.

PCORS — Private corporate sector savings from NAS scaled by ICI.

PME — Implicit price index for total gross fixed capital formation in machinery and equipment (1980-1 = 100) from NAS.

PUBME — Public gross capital formation in machinery and equipment from NAS deflated by the the implicit price index for total gross fixed capital formation in machinery and equipment (1980-1 = 100) from NAS.

PVTME — Private gross capital formation in machinery and equipment from NAS deflated by the the implicit price index for total gross fixed capital formation in machinery and equipment (1980-1 = 100) from NAS.

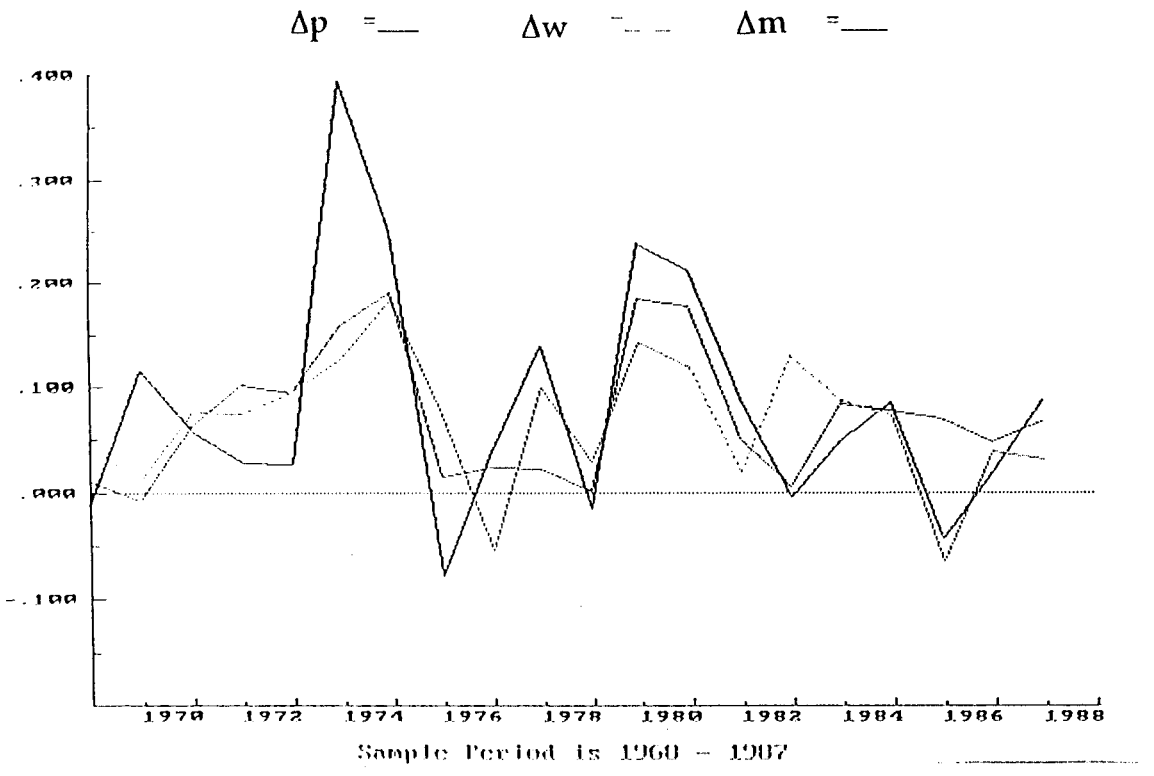
PUBCONS — Public gross capital formation in construction from NAS deflated by the the implicit price index for total gross fixed capital formation in construction (1980-1 = 100) from NAS.

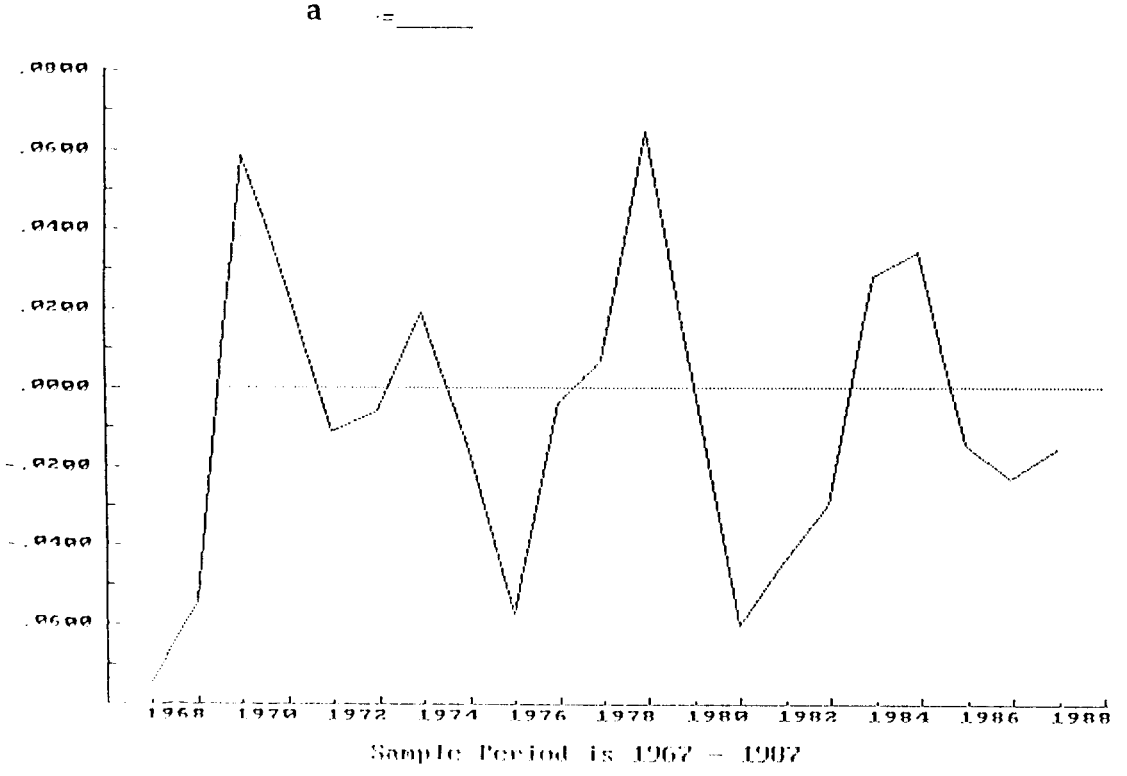
PVTCONS — Private gross capital formation in construction from NAS deflated by the the implicit price index for total gross fixed capital formation in construction (1980-1 = 100) from NAS.

PUBGCF	Public gross capital formation (= PUBCONS + PUBME)
PVTGCF	Private gross capital formation (= PVTCONS + PVTME)
K	Net capital stock (as on March 31 of initial year) at 1980-1 prices from NAS.
L	Employment from ASI.
E	Expenditure on fuel, etc. from ASI deflated by WPI (1980-1 = 100) from TPG for power, light and lubricants.
M	Expenditure on raw material from ASI deflated by industrial raw material price index (1980-1 = 100) from TPG.
V A	Value-added from ASI deflated by WPI (1980-1 = 100) for manufactures from TPG.
GO	Gross output from ASI deflated by implicit deflator for GDP in industry (1980-1 = 100) from NAS.

II. GRAPHS OF MODEL VARIABLES

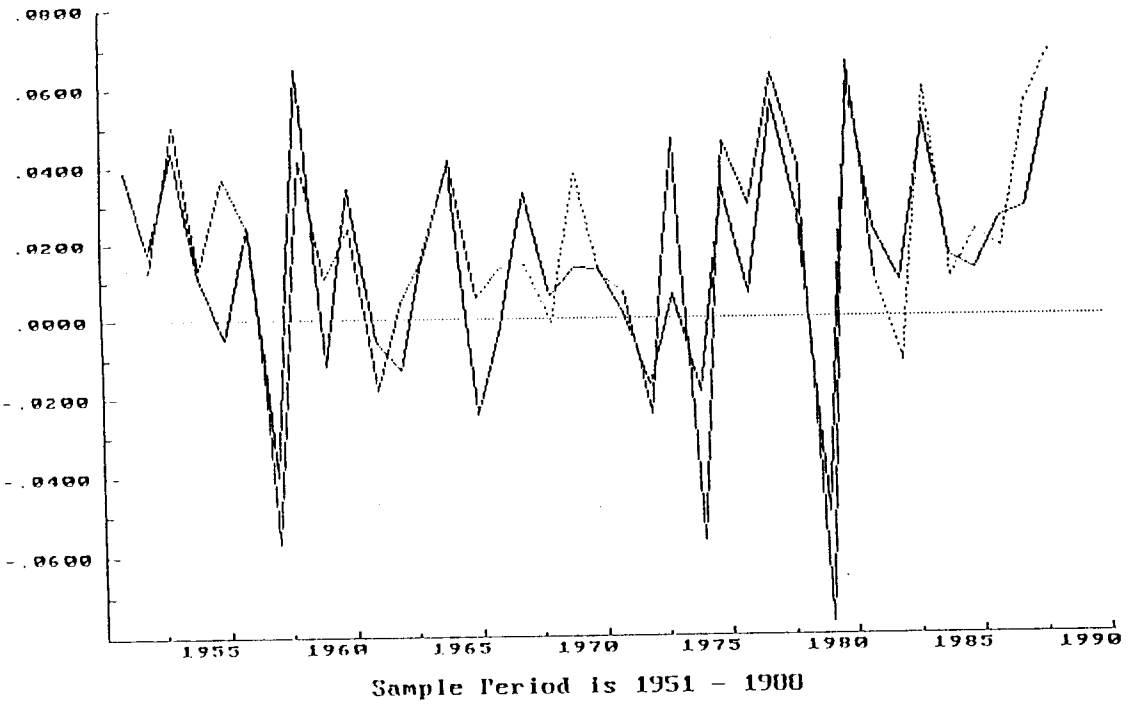
1. Price equation (Ch. V)



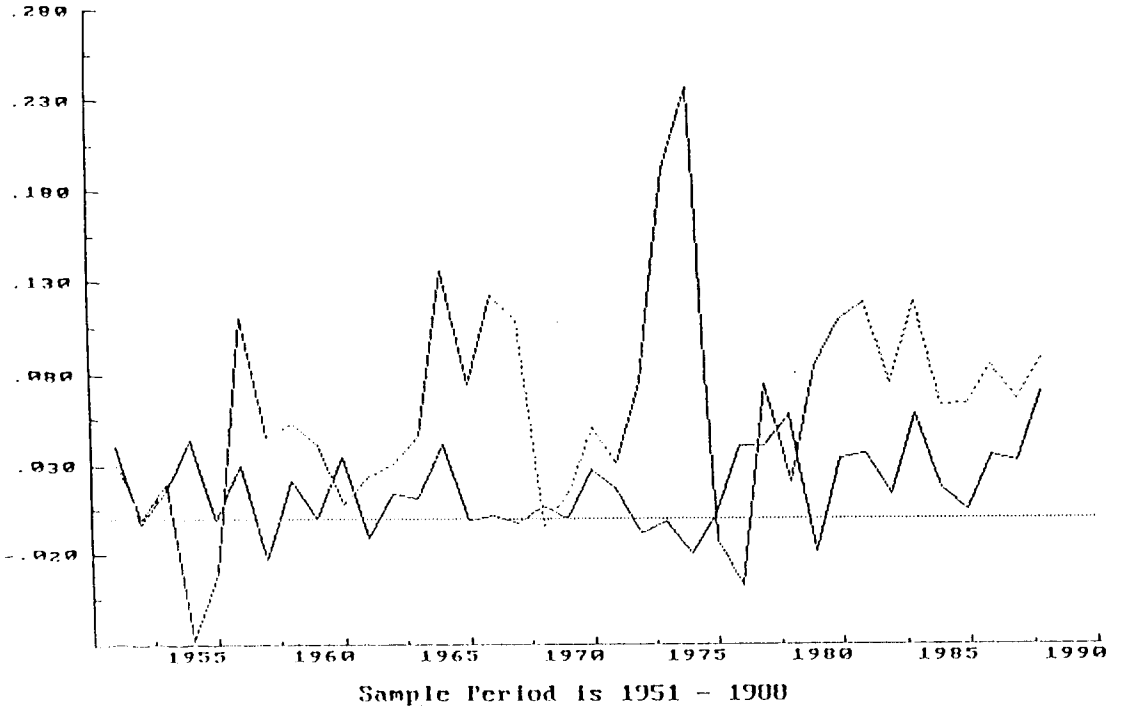


2. Consumption ..(Ch. VI)

Δc =_____ Δy =_____



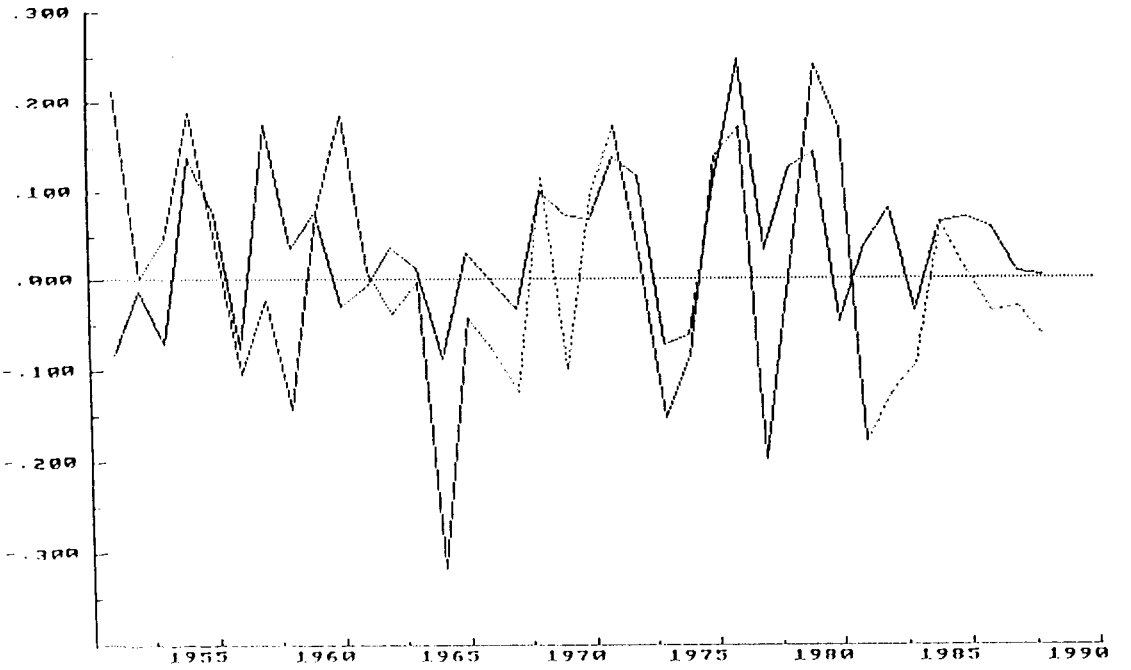
Δci =_____ Δp =_____



SR =_____

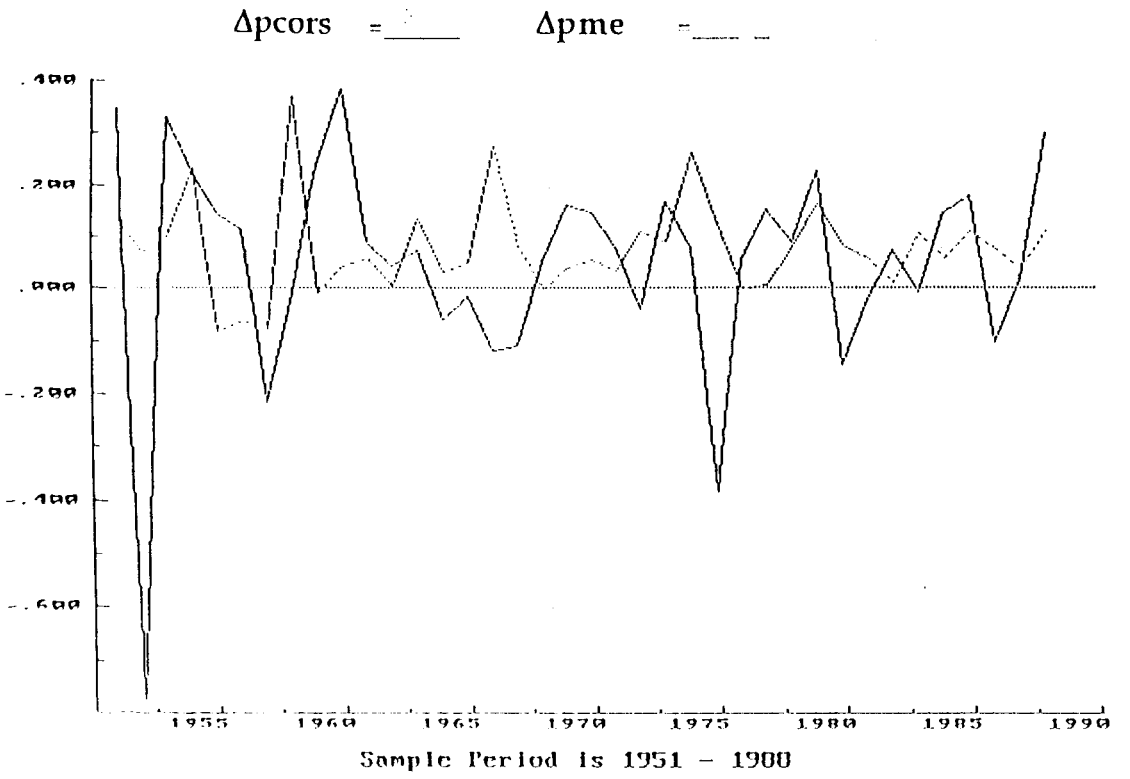
Sample Period is 1950 - 1988

Δl(D/Y) =_____ Δ(Pm/Pf) =_____

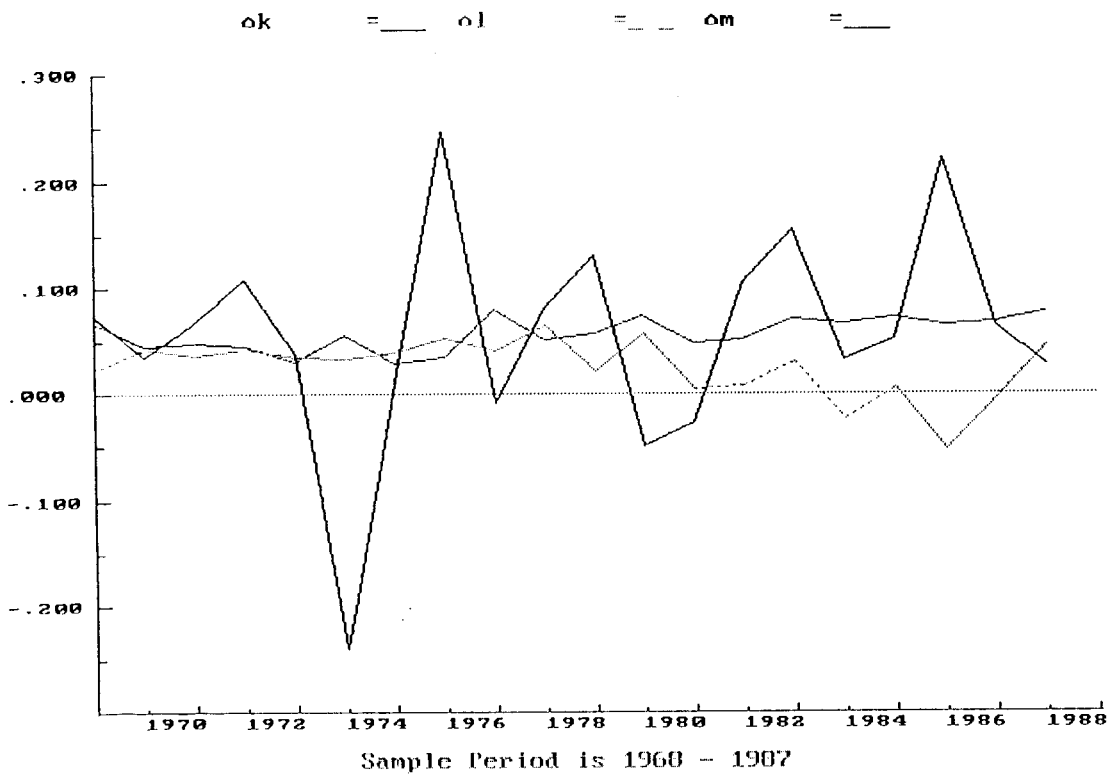


Sample Period is 1951 - 1988

3. Investment (Ch. VII)



4. Production function - Registered industry (Ch. IX)



III. FIGURES ON CAPACITY UTILISATION

Obtained from the Office of the Economic Adviser, Ministry of Industry, Government of India.

Capacity Utilisation of Selected Industries (Values in Percentage)

Serial No.	Industry	Weight Base : 1980-81	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Average Capacity Utilisati
	Basic Industries	17.34585	57	61	63	60	64	67	67	70	70	68	69	65
1	Cement	1.5983	69	72	70	73	71	74	67	72	77	76	80	73
2	Electricity Generation (Thermal)	8.5718	45	47	47	48	50	52	53	57	55	57	54	51
3	Aluminium	0.1726	62	64	65	61	76	73	71	77	76	70	74	70
4	Nitrogenous Fertilisers	1.5227	47	67	67	67	75	76	79	78	82	83	86	73
5	Copper refined	0.2871	56	64	72	74	85	76	88	79	95	87	86	79
6	Alloy and Sal. Steel	0.2320	84	89	99	87	92	75	80	97	70	58	58	81
7	Phosphatic Fertilisers	0.6689	66	67	69	70	85	90	80	74	85	65	76	75
8	Saleable Steel (Integ. Plants)	4.2934	78	82	84	73	78	87	84	90	88	83	86	83
	Consumer Goods	9.0124	77	84	74	69	70	70	72	73	70	73	73	73
9	Bicycles (Org. Sector)	0.2313	88	106	69	81	81	77	84	84	93	93	94	86
10	Scooters/Motor Cycles/Mopeds	0.4108	81	78	84	98	114	89	66	68	70	43	46	75
11	Sugar	1.7591	81	130	125	86	84	93	108	112	96	118	125	105
12	Leather Footwear (Org. Sector)	0.2046	63	67	61	63	63	62	67	75	81	87	73	69
13	Vanaspati	0.5586	60	61	60	57	58	58	58	53	48	42	39	54
14	Rubber Footwear (Org. Sector)	0.1060	77	63	72	70	68	74	78	82	71	73	61	72
15	Paper and paper board	2.7662	75	75	66	62	64	65	64	60	60	62	63	65
16	Cotton Cloth (Mill Sector)	2.9758	78	70	55	63	63	62	61	65	65	63	61	64
	Capital Goods	8.74691	78	78	78	75	73	69	66	67	76	75	82	74
17	Boilers	0.3907	104	97	97	103	54	61	74	58	88	65	74	79
18	Commercial Vehicles	1.3699	80	88	83	86	75	53	40	45	46	57	66	65
19	Ball And Roller Bearings	0.3947	98	89	78	91	89	92	95	109	170	122	103	103
20	Mining Machinery	0.0797	83	87	104	129	60	146	130	155	81	96	91	106
21	Steam/Hydro Turbines	0.0081	58	86	27	76	53	56	79	50	63	70	59	62
22	Transformers	0.2394	78	71	61	67	73	79	87	76	85	94	94	79
23	Paper/Pulp Machinery	0.0825	86	67	40	47	38	37	37	38	42	27	29	44
24	Railway Wagons	0.5565	55	64	85	62	46	42	48	49	67	69	79	61
25	Diesel Locomotives	0.6034	107	81	71	63	78	83	92	84	95	109	100	88
26	Electric Motors	1.2871	60	64	69	77	70	71	70	56	69	68	78	68
27	Ship Building	0.6497	64	68	65	47	61	59	36	31	40	67	87	57
28	Chem./Pharmaceutical Machinery	0.2593	102	85	94	103	65	84	52	77	93	45	61	78
29	ACSR/AA Conductors	0.3124	62	63	43	46	52	44	33	30	21	32	40	42
30	Textile Machinery	0.7608	76	83	79	59	80	70	77	75	100	85	93	80
31	Sugar Machinery	0.1789	47	57	72	82	73	122	65	117	58	37	48	71
32	Tractors	0.6223	101	94	70	83	94	85	89	92	122	99	114	95
33	Earth Moving Equipment	0.3004	33	58	110	90	79	42	49	44	49	50	60	60
34	Machine Tools	0.6511	93	86	93	80	89	83	88	111	79	99	100	91
	Intermediate Goods	9.1210	78	74	69	73	76	71	76	78	78	78	81	75
35	L.D. Polyethylene	0.3095	78	81	95	89	88	83	72	99	103	74	75	85
36	Polyvinyle Chloride	0.0880	54	45	49	74	72	84	93	79	86	86	89	74
37	Automobile tyres	0.6968	94	90	77	83	84	76	80	91	91	75	75	83
38	Polypropylene	0.0482	56	64	80	81	91	80	78	86	70	81	74	77
39	Petroleum Products	1.5192	76	74	82	87	93	70	93	91	93	93	94	86
40	H.D. Polyethylene	0.0735	81	106	109	121	130	68	82	75	79	69	68	90
41	Methanol	0.0513	92	96	94	103	103	70	97	100	92	89	96	94
42	Caprolactum	0.0747	66	50	66	106	81	96	91	85	107	103	100	86
43	Phenol	0.0399	59	48	70	83	91	84	86	45	67	75	70	71
44	Dry Cells	0.1983	79	73	74	65	71	104	72	74	59	56	54	71
45	DRI	0.0795	96	114	76	84	70	41	72	85	92	91	94	83
46	Storage Batteries	0.1587	63	72	71	45	75	68	90	87	97	114	108	81
47	Cotton Yarn	5.7834	77	72	62	66	69	69	70	71	70	73	78	71

REFERENCES

Abadir, K. (1993). 'OLS Bias in a Nonstationary Autoregression', *Econometric Theory*, 9, pp. 81-93.

Ahluwalia, I.J. (1985): *Industrial Growth in India - Stagnation since the Mid-Sixties*, Delhi, Oxford.

Ahluwalia,I.J. (1991): *Productivity and Growth in Indian Manufacturing*, Delhi, Oxford.

Aigner, D,J. and Goldfeld, S.M. (1974). 'Estimation and prediction from aggregate data when aggregates are measured more accurately than their components', *Econometrica*, 42, pp. 113-34.

Alagh, Y.K. (1985). 'Some Aspects of Planning Policies in India', *G.B.Pant Memorial Lectures*, Allahabad.

Alesina, A. (1989). 'Politics and Business Cycles in Industrial Democracies', *Economic Policy - A European Forum*, 0, 8, pp. 55-98.

Ando, A. and Modigliani, F. (1963). 'The "Life Cycle" Hypothesis of Saving: Aggregate Implications and Tests', *American Economic Review*, 53, pp. 55-84.

Aoki, M. (1988). 'Cointegration, Error Correction and Aggregation in Dynamic Models', *Oxford Bulletin of Economics and Statistics*, 50, pp. 85-95.

Arida, P. and Taylor, L. (1989). 'Short-run macroeconomics', in Chenery, H. and Srinivasan, T.N. (eds.), *Handbook of Development Economics*, Vol. 2, New York, North-Holland.

Bagchi, A.K. (1970). 'Long-Term Constraints on India's Industrial Growth, 1951-68', in Robinson, E.A.G. and Kidron, M. (eds.), *Economic Development in South Asia*, London, Macmillan.

Bagchi, A.K. (1982). *The Political Economy of Underdevelopment*, Cambridge University Press.

Bagchi, A.K. (1987). *Public intervention and industrial restructuring in China, India and Republic of Korea*, New Delhi, ILO.

Bagchi, A.K. and Bannerjee, N. (eds.) (1983). *Change and Choice in Indian Industry*, Calcutta, K.P.Bagchi.

Balakrishnan, P. (1991). *Pricing and Inflation in India*, Oxford University Press, Delhi.

Banerjee, A. and Dolado, J. (1988). 'Tests of the Life Cycle-Permanent Income Hypothesis in the Presence of Random Walks: Asymptotic Theory and Small-Sample Interpretations', *Oxford Economic Papers*, 40, pp. 610-33.

Banerjee, A., Dolado, J., Hendry, D.F., and Smith, G. (1986). 'Exploring Equilibrium Relationships Through Static Models: Some Monte Carlo Evidence', *Oxford Bulletin of Economics and Statistics*, 48, pp. 253-77.

Banerjee, A., Galbraith, J.W., and Dolado, J. (1988). 'Dynamic Specification with the General Error Correction Form', Oxford University Applied Economics Discussion Paper.

Banerjee, A., Dolado, J., Galbraith, J., and Hendry, D.F. (1993). *Co-Integration, Error Correction, and the Econometric Analysis of Non-Stationary Data,* Oxford, Oxford University Press.

Barker, T. and Pesaran, M.H. (eds.) (1990). *Disaggregation in Econometric Modelling.* London and New York, Routledge.

Barro, R. and Lee, J. (1993). "International Comparisons of Educational Attainment." Paper presented at the World Bank Conference "How Do National Policies Affect Long-run Growth?"

Barro, R.J. and Sala-i-Martin, X. (1992). 'Convergence', *Journal of Political Economy*, 100, 223-51.

Baumol, W.J. and Wolff, E.N. (1988). 'Productivity Growth, Convergence and Welfare: Reply', *American Economic Review*, 78, pp. 1155-9.

Baxter, M. and King, R.G. (1990). 'Productive externalities and cyclical volatility', Center for Economic Research, University of Rochester, Working Paper 245.

Bean, C. (1981). 'An econometric model of manufacturing investment in the United Kingdom', *Economic Journal*, 91, pp. 106-21.

Bean, C. (1990). 'Endogenous Growth and the Procyclical Behaviour of Productivity', *European Economic Review*, 34, pp. 355-63.

Bergsten, C.F. and Noland, M. (1993). *Reconciliable Differences? United States - Japan Economic Conflict,* Institute for International Economics, Washington, D.C.

Berndt, E.R. and Morrison, C.J. (1981). 'Capacity utilisation: underlying economic theory and an alternative approach', *American Economic Review*, 71, Proceedings pp. 48-52.

Bhagwati, J.N. and Desai, P. (1970). *India: Planning for Industrialisation.* Oxford University Press.

Bhagwati, J.N. and Srinivasan, T.N. (1975). *Foreign Trade Regimes and Economic Development: India.* Columbia University Press, New York.

Bhargava, S. and Joshi, V. (1990). 'Increase in India's Growth Rate: Facts and a Tentative Explanation', *Economic and Political Weekly*, 25, 48, 49.

Bhaskar, V. (1990). 'The Inter-Sectoral Terms of Trade and Industrial Demand', Delhi School of Economics Working Paper 90/04.

Blangiewicz, M. and Charemza, W.W. (1990). 'Cointegration in Small Samples: Empirical Percentiles, Drifting Moments and Customized Testing', *Oxford Bulletin of Economics and Statistics*, 52, 3.

Blejer, M. and Khan, M. (1984). 'Government Policy and Private Investment in Developing Countries'. *IMF Staff Papers*, V31(2), pp. 379-403.

Blinder, A.S. and Maccini, L.J. (1991). 'Taking Stock: A critical assessment of Recent Research on Inventories', *Journal of Economic Perspectives*, 5, pp. 73-96.

Blundell, R. (1988). 'Consumer Behaviour: Theory and Empirical Evidence - a Survey', *Economic Journal*, 98, pp. 16-65.

Bose, A (1989). 'Short Period Equilibrium in a Less Developed Economy', in Rakshit (1989).

Bulow, J., Geanakopolos, and Klemperer, P. (1985). "Holding Idle Capacity to Deter Entry: The Role of Investment in Entry Deterrence". *Economic Journal*, Vol 95, pp. 178-82.

Campbell, J.Y. and Mankiw, N.G. (1991). 'The response of consumption to income: A cross-country investigation', *European Economic Review*, 35, pp. 723-67.

Campbell, J.Y. and Perron, P. (1991). 'Pitfalls and Opportunities: What Macroeconomists Should Know about Unit Roots', *NBER Macroeconomics Annual*, pp. 141-201.

Cardoso, E.A. and Levy, S. (1988). 'Mexico', in Dornbusch, R. and Helmers, F. (eds.), *The Open Economy: Tools for policymakers in developing countries*, Oxford University Press for the World Bank.

Carruth, A. and Henley, A. (1990). 'Can Existing Consumption Functions Forecast Consumer Spending in the Late 1980s?', *Oxford Bulletin of Economics and Statistics*, 52, pp. 275-84.

Chandrashekhar, C.P. (1988). 'Aspects of Growth and Structural Change in Indian Industry', *Economic and Political Weekly*, 23, pp. 2359-70.

Chatterji, M. (1992). 'Convergence Clubs and Endogenous Growth', *Oxford Review of Economic Policy*, 8, 4, pp. 57-69.

Chatterji, R. (1989). *The Behaviour of Industrial Prices in India*, Oxford University Press, Delhi.

Choi, I. (1992). 'Durbin-Hausman Tests for a Unit Root', *Oxford Bulletin of Economics and Statistics*, 54, pp. 289-304.

Chow, G.C. and Corsi, P. (eds.) (1982). *Evaluating the Reliability of Macroeconomic Models*. New York: Wiley.

Clements, M (1989). 'The Estimation and Testing of Cointegrating Vectors: A Survey of Recent Approaches and An Application to the U.K. Non-Durable Consumption Function', Oxford University Applied Economics Discussion Paper.

Cooley, T.F. and LeRoy, S.F. (1985). 'Atheoretical Macroeconometrics: a Critique', *Journal of Monetary Economics*, 16, pp. 283-308.

Coutts, K.J., Godley, W.A.H. and Nordhaus, W.D. (1978). *Industrial Pricing in the U.K.*, Cambridge University Press.

Darnell, A.C. and Evans, J.L. (1990). *The limits of econometrics*. Aldershot, Elgar.

Davidson, J.E. and Hendry, D.F. (1981). 'Interpreting econometric evidence: consumers' evidence in the U.K.', *European Economic Review*, 16, pp. 177-92.

Davidson, J.E., Hendry, D.F., Srba, F. and Yeo, S. (1978). 'Econometric Modelling of the Aggregate Time Series Relationship Between Consumers' Expenditure and Income in the United Kingdom', *Economic Journal*, 88, pp. 661-92.

De Long, J.B. and Summers, L. (1991). 'Equipment Investment and Economic Growth', *Quarterly Journal of Economics*, 16, pp. 445-502.

De Long, J.B. and Summers, L. (1992). 'Macroeconomic Policy and Long-Run Growth', *Federal Reserve Bank of Kansas City Economic Review*, 77, pp. 5-30.

Deaton, A. and Muellbauer, J.N.J. (1980). *Economics ad Consumer Behaviour*, Cambridge University Press.

Denison, E.F. (1962). *The Sources of Economic Growth in the United States and the Alternatives Before Us*. New York, Committee for Economic Development.

Denison, E.F. (1979). *Accounting for Slower Economic Growth: The United States in the 1970s.* Washington, D.C., The Brookings Institution.

Desai, A. (1984). 'The Slow Rate of Industrialisation: A Second Look', *Economic and Political Weekly,* 19, pp. 1267-72.

Desai, M.J. (1973). 'Macro Econometric Models for India: A Survey', *Sankhya,* series B, vol. 3,part 2, pp. 169-206.

Diamond, P. (1990) (ed.). *Growth/Productivity/Unemployment,* MIT Press.

Dickey, D.A. and Fuller, W. (1979). 'Distribution of the Estimators for Autoregressive Time Series with a Unit Root', *Journal of the American Statistical Association,* 74, pp. 427-31.

Dickey, D.A. and Fuller, W. (1981). 'Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root', *Econometrica,* 49, pp. 1057-72.

Dixit, A. (1990). 'Growth Theory after Thirty Years', in Diamond, P. (ed.), *Growth/Productivity/Unemployment,* MIT Press.

Dolado, J., Galbraith, J.W. and Banerjee, A. (1991). 'Estimating Intertemporal Quadratic Adjustment Cost Models with Integrated Series', *International Economic Review,* 32, pp. 919-36.

Doornik, J.A. and Hendry, D.F. (1992)..*PcGive version 7: An Interactive Econometric Modelling System,* University of Oxford.

Easterly, W. and Rebelo, S. (1993). "Fiscal Policy and Economic Growth: an Empirical Investigation." Paper presented at the World Bank Conference "How Do National Policies Affect Long-run Growth?"

Easterly, W., Kremer, M., Pritchett, L. and Summers, L. (1992). "Good Policy or Good Luck? Country Growth Performance and Temporary Shocks." Paper presented at the World Bank Conference "How Do National Policies Affect Long-run Growth?"

Engle, R.F. and Granger, C. (1987). 'Cointegration and Error Correction: Representation, Estimation and Testing', *Econometrica,* 55, pp. 251-76.

Engle, R.F. and Yoo,S. (1987). 'Forecasting and Testing in Cointegrated Systems', *Journal of Econometrics,* 35, pp. 143-59.

Engle, R.F., Hendry, D.F., and Richard, J.-F. (1983). 'Exogeneity', *Econometrica,* 51, 277-304.

Export-Import Bank of India, (1991). 'How Import Intensive are Indian Exports?'. *Exim Bank Occasional Paper*, No. 16.

Faini, R., Clavijo, F. and Senhadji-Semlali, A. (1992). 'The fallacy of composition argument - Is it relevant for LDCs' manufactures exports?'. *European Economic Review* 36, pp. 865-81.

Fallon, P.R. and Lucas, R.E.B. (1991). 'Job Security Regulations and the Dynamic Demand for Industrial Labor in India and Zimbabwe', Mimeo, The World Bank.

Favero, C. (1989). 'Testing for Superexogeneity: The Case of the Term Structure of Interest Rates', Discussion Paper 67, Oxford Institute of Economics and Statistics.

Fischer, S. (1991). 'Growth, Macroeconomics, and Development', *NBER Macroeconomics Annual 1991*, pp. 329-64.

Fischer, S. (1993). "Macroeconomic Factors in Growth". Paper presented at the World Bank Conference "How Do National Policies Affect Long-run Growth?"

Friedman, M. (1957). *A Theory of the Consumption Function.* Princeton University Press.

Ghosh, J. (1988). 'Intersectoral Terms of Trade, Agricultural Growth and the Pattern of Demand', *Social Scientist*, 9-27.

Ghosh,J. and Singh, A. (1988). 'Import Liberalisation and the New Industrial Strategy: An Analysis of Their Impact on Output and Employment', *Economic and Political Weekly*, 23, pp. 2313-42.

Gilbert, C.L. (1986). 'Professor Hendry's Econometric Methodology', *Oxford Bulletin of Economics and Statistics*, 48, 3, pp. 283-307.

Gilbert, C.L. (1989). 'LSE and the British Approach to Time Series Econometrics', *Oxford Economic Papers*, 41, pp. 108-28.

Goldar, B.N. (1986 a). 'Import Substitution, Industrial Concentration and Productivity Growth in Indian Manufacturing', *Oxford Bulletin of Economics and Statistics*, 48, pp. 143-64.

Goldar, B.N. (1986). *Productivity Growth in Indian Industry*, New Delhi: Allied Publishers.

Goldar, B.N. and Seth, V., (1989). 'Spatial Variations in the Rate of Industrial Growth in India', *Economic and Political Weekly*, 24, pp. 1237-40.

Government of India (1978). *Report of the Committee on Imports-Exports Policies and Procedures,* Headed by P.C.Alexander, Ministry of Commerce.

Government of India (1979). *Report of the Committee on Controls and Subsidies,* Headed by V.Dagli, Ministry of Finance.

Government of India (1980 a). *Report of the National Transport Policy Committee,* Headed by B.D.Pande, Planning Commission.

Government of India (1980 b). *Report of the Committee on Power,* Headed by V.G. Rajadhyaksha, Ministry of Energy and Coal.

Government of India (1980 c). *Report of the Committee on Export Strategy,* Headed by P.Tandon, Ministry of Commerce.

Government of India (1984). *Report of the Committee on Trade Policies,* Headed by Abid Hussain, Ministry of Commerce.

Government of India (1985 a). *Long Term Fiscal Policy,* Ministry Of Finance.

Government of India (1985 b). *Report of the Committee to Examine Principles of a Possible Shift from Physical to Financial Controls,* Headed by M.Narasimham, Ministry of Finance.

Government of India (1991). *Statement on Industrial Policy,* Ministry of Industry.

Government of India (1993). *Report of the Committee on Tax Reforms,* Headed by R.Chelliah, Ministry of Finance.

Government of India, Ministry of Finance (1993). *Economic Reforms: Two Years After and the Task Ahead,* Discussion Paper.

Government of India. Annual Reports, Various Ministries, (Various Issues).

Government of India. Economic Survey, (Various Issues).

Granger, C. (1986). 'Developments in the Study of Cointegrated Economic Variables', *Oxford Bulletin of Economics and Statistics,* 68, 213-28.

Granger, C. (1988). 'Aggregation of time series variables - a survey', *Institute for Empirical Macroeconomics,* Discussion Paper 1, Federal Reserve Bank of Minneapolis.

Granger, C. and Newbold, P. (1974). 'Spurious Regressions in Econometrics', *Journal of Econometrics,* 2, pp. 111-20.

Greene, J. and Villanueva, D. (1991). 'Private Investment in Developing Countries'. *IMF Staff Papers,* V38(1), pp. 33-58.

Griliches, Z. and Jorgenson, D.W. (1966). 'The Explanation of Productivity Change', *Review of Economic Studies*, 34, pp. 249-283.

Grossman, G.M. and Helpman, E. (1991 a). 'Trade, Knowledge Spillovers, and Growth', *European Economic Review*, 35, pp. 517-26.

Grossman, G.M. and Helpman, E. (1991 b). *Innovation and growth in the global economy*, Cambridge, MIT Press.

Grunfeld, Y. and Griliches, Z. (1960). 'Is Aggregation Necessarily Bad?', *Review of Economics and Statistics*, 42, pp. 1-13.

Hall, R.E. (1990). 'Invariance Properties of Solow's Productivity Residual', in Diamond, P. (ed.), *Growth/Productivity/Unemployment*, MIT Press

Hall, R.L. and Hitch, C.J. (1939). 'Price Theory and Business Behaviour', *Oxford Economic Papers*, 2, pp. 12-45.

Hall, S.G. (1986). 'An Application of the Granger & Engle Two-Step Estimation Procedure to United Kingdom Aggregate Wage Data', *Oxford Bulletin of Economics and Statistics*, 48, pp. 229-39.

Hall, S.G. and Drobny, A. (1989). 'An Investigation of the Long Run Properties of Aggregate Non-Durable Consumption Expenditure in the United Kingdom', *Economic Journal*, 99, pp. 454-60.

Hazari, R.K. (1966). *The Structure of the Corporate Private Sector. A Study of Concentration Ownership and Control.* Bombay, Asia Publishing House.

Hendry, D.F. (1979). 'Predictive failure and econometric modelling in macroeconomics: the transactions demand for money', in Ormerod, P. (ed.), *Economic Modelling*, Heinemann, London. pp. 217-42.

Hendry, D.F. (1986). 'Economic Modelling with Cointegrated Variables', *Oxford Bulletin of Economics and Statistics*, 48, pp. 201-12.

Hendry, D.F. (1988). 'Encompassing', *National Institute Economic Review*, 125, pp.88-92.

Hendry, D.F. (1989). *PC-GIVE: An Interactive Econometric Modelling System, Oxford*, Institute of Economics and Statistics.

Hendry, D.F. (1991). 'Comments', *European Economic Review*, 35, pp. 764-7.

Hendry, D.F. and Mizon, G.E. (1978). 'Serial Correlation as a Convenient Simplification, Not a Nuisance: Of Comment on a Study of the Demand for Money by the Bank of England', *Economic Journal*, 88, pp. 549-63.

Hendry, D.F., Muellbauer, J. and Murphy, A. (1990). 'The Econometrics of DHSY', in Winch, D. and Hey, J. (eds.), *A century of economics*, Oxford, Basil Blackwell.

Hilferding, R. (1910). *Finance Capital; A Study of the Latest Phase of Capitalist Development.*

Hylleberg, S. and Mizon, G.E. (1989). 'Cointegration and Error Correction Mechanisms', *Economic Journal*, 99, pp. Supplement 113-25.

Intriligator, M. (1978). *Econometric Models, Techniques and Applications.* Englewood Cliffs, N.J.: Prentice-Hall, Inc.

Jeffreys, H. (1967). *Theory of Probability.* Oxford University Press.

Jenkinson, T.J. (1986). 'Testing Neoclassical Theories of Labour Demand: An Application of Cointegration Techniques', *Oxford Bulletin of Economics and Statistics*, 48, pp. 241-51.

Johansen, S. (1988). 'Statistical Analysis of Cointegration Vectors', *Journal of Economic Dynamics and Control*, 12, 231-54.

Johansen, S. (1992). 'Determination of cointegration rank in the presence of a linear trend', *Oxford Bulletin of Economics and Statistics*, 54, pp. 383-397.

Johansen, S. and Juselius, K. (1990). 'Maximum Likelihood Estimation and Inference on Cointegration - with Applications to the Demand for Money', *Oxford Bulletin of Economics and Statistics*, 52, pp. 169-210.

Johnson, C., Tyson, L.D., and Zysman, J. (eds.) (1990). *Politics and Productivity: How Japan's Develpment Strategy Works*, Harper Business, New York.

Jorgenson, D.W. (1963). 'Capital Theory and Investment Behaviour', *American Economic Review*, 53, pp. 247-56.

Jorgenson, D.W. (1985). 'Econometric methods for modelling producer behaviour', in Griliches, Z. and Intriligator, M.D., (eds.), *Handbook of Econometrics*, vol 3, Amsterdam: North-Holland.

Jorgenson, D.W., Gollop, F.M. and Fraumeni, B.M. (1987). *Productivity and US Economic Growth.* Cambridge, MA: Harvard University Press.

Joshi, V. (1984). 'The Nominal and Real Effective Exchange Rate of the Indian Rupee', *RBI Occasional Papers*, 5, 1.

Joshi,V., and Little, I.M.D. (1989). 'Indian Macroeconomic Policies', in Calvo, G, et al (eds.), *Debt, stabilisation and development: Essays in memory of Carlos Diaz-Alejandro,* Oxford, Blackwell.

Kaldor, N. (1966). 'Causes of the Slow Rate of Economic Growth in the UK', reprinted in Kaldor, N., (1978), *Further Essays on Economic Theory,* London, Duckworth.

Kalecki, M. (1954). 'Costs and Prices', reprinted in Kalecki (1971), *Selected Essays on the Dynamics of the Capitalist Economy,* Cambridge University Press.

Kalecki, M. (1970). 'Problems of Financing Economic Development in a Mixed Economy', in Kalecki, (1972), *Selected Essays on the Economic Growth of the Socialist and the Mixed Economies,* Cambridge University Press.

Kalecki, M. (1971). *Selected Essays on the Dynamics of the Capitalist Economy,* Cambridge University Press.

Kelkar, V.L. and Kumar, R. (1990). 'Industrial Growth in the Eighties: Emerging Policy Issues', *Economic and Political Weekly,* pp. 209-22.

Keynes, J.M. (1936). *The General Theory of Employment, Interest and Money.* London, Macmillan.

Kiviet, J.F. and Phillips, G.D.A. (1992). 'Exact Similar Tests for Unit Roots and Cointegration', *Oxford Bulletin of Economics and Statistics,* 54, pp. 349-67.

Klein, L.R. (1985). *Economic Theory and Econometrics.* Oxford: Basil Blackwell.

Klein, L.R., Bodkin, R. and Marwaha, K. (1991). *A History of Macroeconometric Model-Building.* Edward Elgar.

Komiya, R., Okuno, M., and Suzumura, K. (eds.) (1988). *Industrial Policy of Japan,* Academic Press, Tokyo.

Kornai, J (1980). *The Economics of Shortage* (2 vols.), North-Holland, Amsterdam.

Krishna, K.L. (1987). 'Industrial growth and productivity in India', in Brahmananda, P.R., and Panchamukhi, V.R., (eds.), *The Development Process of the Indian Economy,* Bombay: Himalaya Publishing House.

Krishnaji, N. (1984). 'The Demand Constraint - A Note on Role of Foodgrain Prices and Income Inequality', *Economic and Political Weekly,* 19, pp.1261- 1266.

Krishnamurty, K. and Pandit, V. (1984). 'Macroeconometric Modelling of the Indian Economy: An Overview', *Indian Economic Review*, 19, pp. 1-15.

Krishnamurty, K. and V. Pandit (1985). *Macroeconometric Modelling of the Indian Economy: Studies on Inflation and Growth.* Delhi: Hindustan Publishing.

Krishnamurty, K., Saibaba, P., and Kazmi, N.A. (1984). 'Inflation and Growth: A Model for India', *Indian Economic Review*, 19, pp. 16-111.

Krugman, P. (1988). 'Endogenous innovations, international trade and growth', Paper presented at SUNY, Buffalo conference on *The Problem of Development.*

Kumar, A. (1988). 'The Black Economy, Services and Surplus: The Growing Triad', J.N.U. School of Social Sciences Working Paper, SSS/ 1988/ 3.

Kurien, C.T. (1989). 'Indian Economy in the 1980s and On to the 1990s', *Economic and Political Weekly*, 24.

Lahiri, A.K., Madhur, S., Purkayastha, D., and Roy, P. (1984). 'The Industrial Sector in India: A Quantitative Analysis', *Economic and Political Weekly*, 19, pp. 1285-306.

Lasserre. P. and Ouellette, P. (1991). 'The measurement of productivity and scarcity rents: The case of asbestos in Canada', *Journal of Econometrics*, 48, pp. 287-312.

Leamer, E.E. (1983). 'Let's Take the Con out of Econometrics', *American Economic Review*, 23, 1, pp. 31-43.

Lee, E. (1980). 'Export-Led Industrialisation in Asia: An Overview', in Lee (1980 a).

Lee, E. (ed.)(1980 a). *Export-Led Industrialisation and Development*, ILO, Singapore.

Llewellyn, J., Potter, S. and Samuelson, L. (1985). *Economic Forecasting and Policy - the International Dimension.* London: Routledge and Kegan Paul.

Lucas, R.E.B. (1988). 'Demand for India's manufactured exports', *Journal of Development Economics*, vol. 29, pp. 63-75.

Lucas, R.E.B. (1989). 'Liberalization of Indian Trade and Industrial Licensing: A Disaggregated Econometric Model with Simulations', *Journal of Development Economics*, vol. 31, pp. 141-175.

Luxembourg, R. (1951): *The Accumulation of Capital,* with an Introduction by Joan Robinson, Routledge and Kegan Paul, London.

Malgrange, P. and Muet, P.A. (eds.) (1985). *Contemporary Macroeconomic Modelling.* Oxford: Blackwell.

Marwaha, K. (1987). 'On Managing the Exchange Rate of the India Rupee: Modelling Post-Bretton Woods Experience', *Journal of Quantitative Economics,* vol. 3, no. 1, pp. 137-61.

Matsuyama, K. (1991). 'Increasing returns, industrialization and indeterminacy of equilibrium', *Quarterly Journal of Economics,* CVI, pp. 615-50.

McKinnon, R. (1973). *Money and Capital in Economic Development.* Washington, D.C., The Brookings Institution.

Miller, E.M. (1983). 'A difficulty in measuring productivity with a perpetual inventory capital stock measure', *Oxford Bulletin of Economics and Statistics,* 45, pp. 297-306.

Mitra, A. (1977). *Terms of Trade and Class Relations.* London, Frank Cass.

Modigliani, F. and Miller, M. (1958). 'The Cost of Capital, Corporation Finance and the Theory of Investment', *American Economic Review,*

Morrison, C.J. (1985). 'On the economic interpretation and measurement of optimal capacity utilisation with anticipatory expectations', *Review of Economic Studies,* 52, pp. 295-310.

Muellbauer, J.N.J. (1986). 'The Assessment - Productivity and Competitiveness in British Manufacturing', *Oxford Review of Economic Policy,* 2, 3, pp. i - xxv.

Mundle, S. (1989). Growth, Acceleration and the Fiscal Constraint, *Mainstream.*

Nadiri, M.I. and Rosen, S. (1969). 'Interrelated Factor Demand Functions', *American Economic Review,* 59, pp. 457-71.

Nagaraj, R. (1989). 'Growth in Manufacturing Output since 1980 - Some Preliminary Findings', *Economic and Political Weekly,* 24, pp. 1481-4.

Nayyar, D. (1976). *India's Exports and Export Policies.* Cambridge University Press.

Nayyar, D. (1978). 'Industrial Development in India: Some Reflections on Growth and Stagnation', *Economic and Political Weekly*, 12, pp. 1265-78.

Nayyar, D. (1987). 'India's Export Performance, 1970-85: Underlying Factors and Constraints', *Economic and Political Weekly*, 22, AN 73-90.

Nelson, C.R. and Plosser, C. (1982). 'Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications', *Journal of Monetary Economics*.

Nickell, S.J. (1978). *The Investment Decisions of Firms*. Cambridge University Press.

Nickell, S.J. (1985). 'Error Correction, Partial Adjustment and All That: An Expository Note', *Oxford Bulletin of Economics and Statistics*, 47, 119-30.

Nishimizu, M. and Robinson, S. (1984). 'Trade Policies and Productivity Change in Semi-Industrialized Countries', *Journal of Development Economics*, 16, pp. 177-206.

Ohmae, K. (1990). *The Borderless World: Power and Strategy in the Interlinked Economy*, Fontana, London.

Okimoto, D. (1989). *Between MITI and the Market: Japanese Industrial Policy for High Technology*, Stanford University Press.

Ormerod, P.A. (ed.) (1979). *Economic Modelling*. London, Heinemann.

Orphanides, A. and Solow, R.M. (1990). 'Money, inflation and growth', in Friedman, B.M. and Hahn, F.H. (eds.), *Handbook of Monetary Economics*, Vol. 1, New York, North-Holland.

Page, J., Birdsall, N., Campos, E., Corden, W.M., Stiglitz, J.E., Easterly, W., Petri, P., and others (1993). *The East Asian Miracle : Economic Growth and Public Policy*. World Bank Policy Research Report, World Bank, Washington D.C.

Pandit, B.L. (1991). *The Growth and Structure of Savings in India*, Bombay, Oxford University Press.

Pandit, V (1984). 'Macroeconomic Adjustments in a Developing Economy: A Medium Term Model of Outputs and Prices in India', *Indian Economic Review* reprinted in Krishnamurty, K. and V. Pandit (1985), *Macroeconometric Modelling of the Indian Economy: Studies on Inflation and Growth*, Delhi, Hindustan Publishing.

Park, Y.C. (1980). 'Export-Led Development: The Korean Experience 1960-78', in Lee (1980 a).

Park, Y.C. (1988). 'Korea', in Dornbusch, R. and Helmers, F. (eds.), *The Open Economy: Tools for policymakers in developing countries*, Oxford University Press for the World Bank.

Patnaik, P. (1975). 'Current Inflation in India', *Social Scientist*, 3, 22-42.

Patnaik, P. (1988). 'A Perspective on the Recent Phase of India's Economic Development', *Social Scientist*, 16, pp. 3-16.

Patnaik, P. and Rao, S.K. (1977). '1975-76: Beginning of the End of Stagnation?', *Social Scientist*, 5.

Perron, P. (1988). 'Trends and random walks in macroeconomic time series: Further evidence from a new approach'. *Journal of Economic dynamics and Control*, 12, 297-332.

Pesaran, M.H., Pierse, R.G. and Kumar, M.S. (1989). 'Econometric Analysis of Aggregation in the Context of Linear Prediction Models', *Econometrica*, 57, pp. 861-88.

Pfefferman, G.P. and Madarassy, A. (1992). 'Trends in Private Investment in Developing Countries, 1992 edition'. *International Finance Corporation Discussion Paper*, 14.

Phillips, P.C.B. and Durlauf, S.N. (1986). 'Multiple Time Series Regression with Integrated Processes', *Review of Economic Studies*, 53, pp. 473-95.

Phillips, P.C.B. and Loretan, M. (1991). 'Estimating Long-run Economic Equilibria', *Review of Economic Studies*, 58, pp. 407-36.

Phillips, P.C.B. and Ouliaris, S. (1988). 'Testing for Cointegration using Principal Components Methods', *Journal of Economic Dynamics and Control*, 12, pp. 205-30.

Phillips, P.C.B. and Ouliaris, S. (1990). 'Asymptotic Properties of Residual Based Tests for Cointegration', *Econometrica*, 58, pp. 165-93.

Pindyck, R.S. and Rubinfield, D.L. (1991). *Econometric Models and Economic Forecasts*. New York: McGraw-Hill.

Popper, K.R. (1934). *The Logic of Scientific Discovery*. London, Hutchinson.

Pradhan, B.K., Ratha, D.K. and Sarma, A. (1990). 'Complementarity between Public and Private Investment in India'. *Journal of Development Economics*, 33, 101-16.

Precious, M. (1987). *Rational Expectations, Non-market Clearing, and Investment Theory*. Oxford, Clarendon Press.

Raj, K.N. (1976). 'Growth and Stagnation in Indian Industrial Development', *Economic and Political Weekly*, 11, pp. 223-36.

Raj, K.N. (1984). 'Some Observations on Economic Growth in India over the period 1952-53 to 1982-83', *Economic and Political Weekly*, 19, pp. 1801-4.

Rajaraman, I. (1991). 'Impact of Real Exchange Rate Movements On Selected Indian Industrial Exports', *Economic and Political Weekly*, 26, pp. 669-78.

Rakshit, M. (1989). 'Effective Demand in a Developing Country: Approaches and Issues', in Rakshit, M. (ed.) (1989 a), *Studies in the Macroeconomics of Developing Countries*, New Delhi: Oxford University Press..

Rakshit, M. (ed.) (1989 a). *Studies in the Macroeconomics of Developing Countries*, New Delhi: Oxford University Press.

Ramana, R. (1984). 'Performance of the Capital Goods Sector in India, 1955-79', *Economic and Political Weekly*, 19, pp. 1311-8.

Ray Chaudhuri, U.D. (1988). 'New Series on National Accounts Statistics: Some Comments', *Economic and Political Weekly*, 23.

Reich, R.B. (1992). *The Work of Nations*, New York, Vintage.

Reimers, H.E. (1991). "Comparisons of Tests for Multivariate Co-integration", Discussion Paper no. 58, Christian Albrechts University, Kiel.

Rivera-Batiz, L. and Romer, P.M. (1991). 'Economic Integration and Endogenous Growth', *Quarterly Journal of Economics*, 106, pp. 531-55.

Romer, P.M. (1986). 'Increasing returns and long-run growth', *Journal of Political Economy*, 94, pp. 1002-37.

Romer, P.M. (1987). 'Crazy Explanations for the Productivity Slowdown', *NBER Macroeconomics Annual*, pp. 162-201.

Romer, P.M. (1990). 'Endogenous Technological Change', *Journal of Political Economy*, 98, pp. S71-S102.

Rotemberg, J. and Summers, L. (1990). 'Inflexible prices and procyclical productivity', *Quarterly Journal of Economics*, 105, pp. 851-74.

Sahay, R. (1990). "Trade Policy and Exess Capacity in Developing Countries". *IMF Staff Papers* , Vol 37, no. 3, pp. 486-508.

Said, S.E. and Dickey, D.A. (1984). 'Testing for Unit Roots in Autoregressive Moving Average Models of Unknown Order', *Biometrika*, 71, pp. 599-604.

Sanyal, A. (1988). 'The Fiscal Crisis and the Monetary System', *Social Scientist*, pp 28-48.

Sargan, J.D. (1964). 'Wages and Prices in the U.K.: A Study in Econometric Methodology', Reprinted in Hendry, D.F. and Wallis, K., (eds,) (1984), *Econometrics and Quantititative Economics*, Blackwell, Oxford.

Sargan, J.D. and Bhargava, A. (1983). 'Testing Residuals from Least Squares Regression for Being Generated by the Gaussian Random Walk', *Econometrica*, 51, pp. 153-74.

Sarkar, H. and Panda, M. (1990). 'Short-Term Forecasting and Policy Analysis Through a Structural Macro Economic Model for India', New Delhi: National Council of Applied Economic Research.

Sawyer, M. (1985). *The Economics of Michal Kalecki*. London: Macmillan.

Schmidt, P. and Phillips, P.C.B. (1992). 'LM Tests for a Unit Root in the Presence of Deterministic Trends', *Oxford Bulletin Of Economics and Statistics*, 54, pp. 257-87.

Scott, M.FG. (1989). *A New View of Economic Growth*, Clarendon.

Scott, M.FG. (1992). 'A New Theory of Endogenous Economic Growth', *Oxford Review of Economic Policy*, 8, 4, pp.29-42.

Sen, A. (1981). *The Agrarian Constraint in Economic Development: The Case of India*, Unpublished Ph.D. Dissertation, Cambridge University.

Sensenbrenner, G. (1991). 'Aggregate investment, the stock market, and the Q model: Robust results for six OECD countries', *European Economic Review*, 35, pp. 769-832.

Shafik, N. (1992). 'Modeling private investment in Egypt'. *Journal of Development Economics*, 39, pp. 263-77.

Shetty, S.L. (1978). 'Structural Retrogression in the Indian Economy since the Mid-Sixties', *Economic and Political Weekly*, 13, pp. 185-244.

Shoven, J.B., and Whalley, J., (1984). 'Applied General Equilibrium Models of Taxation and International Trade', *Journal of Economic Literature*, 22, pp. 1007-51.

Sims, C.A., Stock, J.H. and Watson, M.W. (1990). 'Inference in Linear Time Series Models with Some Unit Roots', *Econometrica*, 58, pp. 113-44.

Singh, M. (1964). *India's Export Trends*, Oxford, Clarendon Press.

Solow, R. (1956). 'A Contribution to the Theory of Economic Growth', *Quarterly Journal of Economics*, 70, pp. 65-94.

Solow, R. (1957). 'Technical Change and the Aggregate Production Function', *Review of Economics and Statistics*, 39, pp. 312-20.

Solow, R. (1988). 'Growth Theory and After', Nobel Laureate Lecture, reprinted in *American Economic Review*, 78, pp. 307-17.

Srinivasan, T.N. and Bhagwati, J.N. (1975). *Foreign Trade Regimes and Economic Development: India*, National Bureau of Economic Research, Columbia University Press.

Srinivasan, T.N. and Whalley, J. (eds.) (1987). *General Equilibrium and Trade Policy Modelling*, M.I.T.Press.

Stiglitz, J.E. (1990). 'Some Retrospective Views on Growth Theory', in Diamond, P. (ed.), *Growth/Productivity/Unemployment*, MIT Press.

Stock, J.H. and Watson, M.W. (1988). 'Testing for Common Trends', *Journal of the American Statistical Association*, 83, pp. 1097-1107.

Stock, J.H., (1987). 'Asymptotic properties of the Least Squares Estimates of Cointegrating Vectors', *Econometrica*, 55, pp. 1035-56.

Stoker, T.M. (1986). 'Simple tests of distributional effects on macroeconomic equations', *Journal of Political Economy*, 94, pp. 763-95.

Summers, L.H. (1990). 'What is the Social Return to Capital Investment?', in Diamond, P. (ed.), *Growth/Productivity/Unemployment*, MIT Press.

Sundararajan, V. and Thakur, S. (1980). 'Public investment, crowding out, and growth: A dynamic model applied to India and Korea'. *IMF Staff Papers*, 27, pp. 814-55.

Taylor, L. (1988). 'Macro Constraints on India's Economic Growth', *Indian Economic Review*, 23, pp. 145-65, reprinted in Taylor, L. (ed.) (1990), *Socially Relevant Policy Analysis: Structuralist Computable General Equilibrium Models for the Developing World.* Cambridge, Mass: MIT Press.

Taylor, L. (ed.) (1990). *Socially Relevant Policy Analysis: Structuralist Computable General Equilibrium Models for the Developing World.* Cambridge, Mass: MIT Press.

Tirole, J. (1991). 'Privatization in Eastern Europe: Incentives and the Economics of Transition', *NBER Macroeconomics Annual 1991,* pp. 221-59.

Tobin, J. and Brainard, W.C. (1977). 'Asset Markets and the Cost of Capital', in Balassa, B. and Nelson, R. (eds.), *Economic Progress, Private Values and Public Policy.*

Tun Wai, U. and Wong, C. (1982). 'Determinants of Private Investment in Developing Countries'. *Journal of Development Studies,* V19(1) pp.19-36.

Tyson, L. D. (1992). *Who's Bashing Whom? Trade Conflict in High-Technology Industries,* Institute for Intternational Economics, Washington, D.C.

von Ungern-Stenberg, T. (1981). 'Inflation and Savings: International Evidence on Inflation-Induced Income Losses', *Economic Journal,* 91 pp. 961-976.

Wolf, M. (1982). *India's Exports.* Oxford University Press for the World Bank.

World Bank (1989, 1990, 1991). *World Development Report,* Washington D.C..

Yamamura, K. (1986). "Caveat Emptor: The Industrial Policy of Japan", in Krugman, P. (ed.) *Strategic Trade Policy and the New International Economics,* MIT Press, Cambridge, Mass.

Zellner, A. (1986). 'Bayesian analysis in econometrics', *MRG Working Paper,* M8610, University of Southern California.